THE ONTARIO DEPARTMENT OF HIGHWAYS

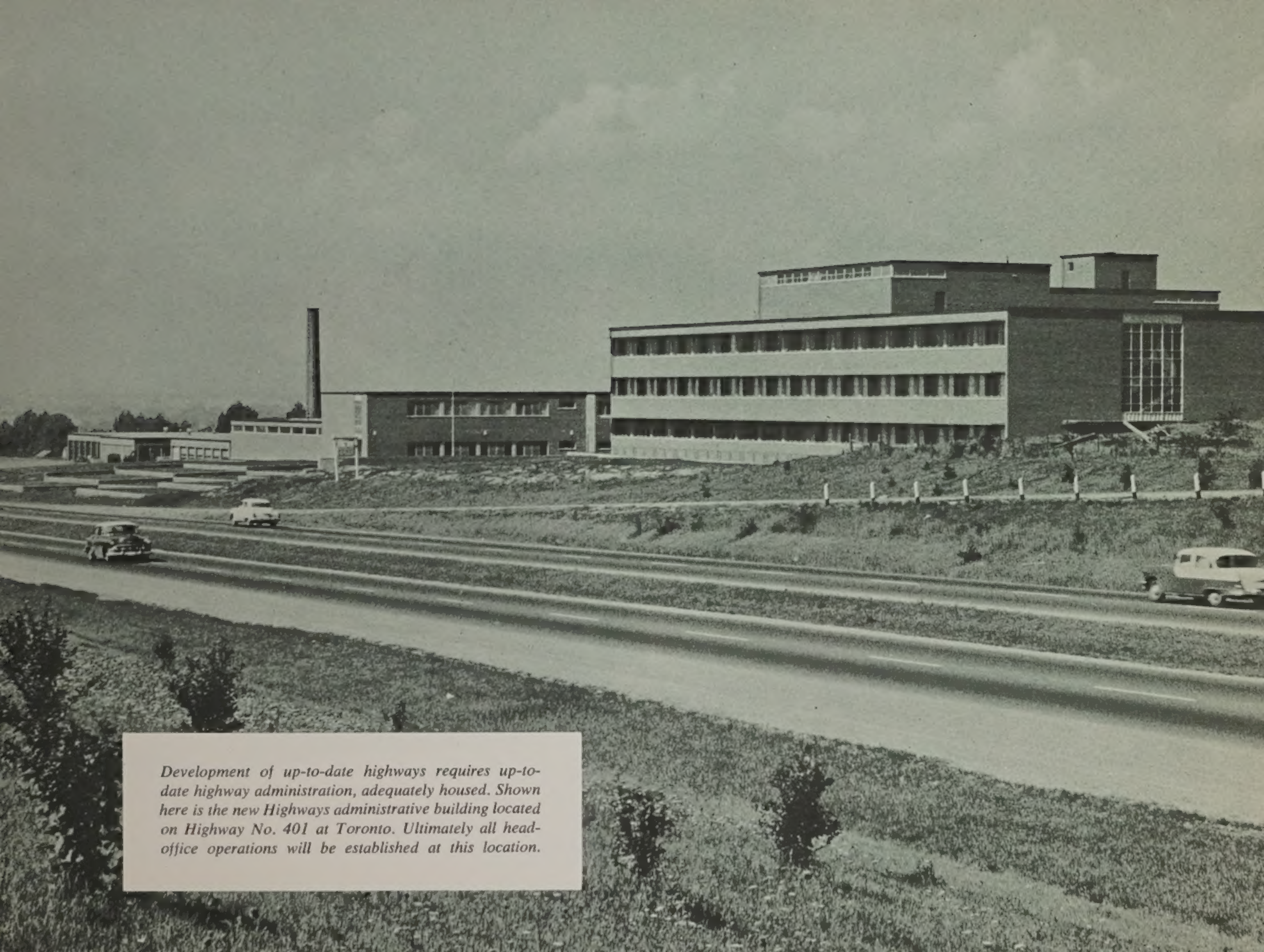
A PLAN FOR ONTARIO HIGHWAYS

AN ENGINEERING STUDY

AN ENGINEERING ANALYSIS OF NEEDS ON KING'S HIGHWAYS AND SECONDARY ROADS

A PLAN FOR ONTARIO HIGHWAYS

A REPORT TO THE GOVERNMENT OF ONTARIO PREPARED BY THE DEPARTMENT OF HIGHWAYS, TORONTO, ONTARIO, DECEMBER 1956



Development of up-to-date highways requires up-to-date highway administration, adequately housed. Shown here is the new Highways administrative building located on Highway No. 401 at Toronto. Ultimately all head-office operations will be established at this location.

ONTARIO

OFFICE OF
DEPUTY MINISTER OF HIGHWAYS

February 14, 1957

Hon. Jas. N. Allan,
Minister of Highways,
Queen's Park, Toronto, Ontario.

Dear Mr. Allan:

Transmitted herewith is an engineering report summarizing the results of intensive studies carried out by the Planning and Design Branch over the past two years. The report is recommended for adoption as the basis for the future planning and financing of Ontario's principal rural highways. The report points to the large backlog of work needed to overcome present deficiencies in the highway system and suggests that improvements should be accelerated as much as possible to meet Ontario's tremendous growth and traffic and to aid its continued economic well-being.

I would like to express my appreciation to all the districts and divisions of the Department that cooperated in this project as well as the several organizations that provided assistance and advice from time to time. The advice and consultation of engineers of the Automotive Safety Foundation were invaluable for the completion of the report.

This initial report is the foundation for continuing study. It is planned to keep it up to date and it will be revised from time to time as conditions warrant. On the basis of this continuing study it is now proposed to develop an advanced planning program which will enable all operations of the Department to be coordinated effectively.

This is only one phase of the highway problem confronting the Province and its municipalities. It is intended that similar studies should go forward to review the problem in the municipalities,whose cooperation will be desired when such studies take place.

Sincerely yours,

W. J. Fulton

W. J. Fulton
Deputy Minister

wjf/lm

MINISTER OF HIGHWAYS
ONTARIO

March 8, 1957

The Honourable Leslie M. Frost, Q.C.,
Prime Minister of Ontario,
Parliament Buildings,
Toronto, Ontario.

My Dear Mr. Frost:

"A Plan for Ontario Highways" is respectfully submitted herewith for your consideration.

This plan includes a comprehensive, factual report on Ontario's highways as they have been developed in the past and as they serve the needs of the Province at the present time. Trends in population and motor vehicle traffic have been analysed and projected to indicate the highway needs of the Province over the next 20 years.

The adequacy or deficiency of existing highways has been noted and a programme of highway construction, replacement and maintenance has been developed to provide for the future. Alternative proposals are submitted to assist in the determination of fiscal policy which must be an integral part of future highway development.

The information contained in the report and the resulting conclusions and recommendations are based on facts developed in the course of a most intensive and thorough engineering and economic study. It is our intention to continue these studies to give effect to changing conditions in the future which could not be anticipated at this time.

The Department of Highways can take necessary action towards the solution of our highway problem only with the understanding and support of the people of Ontario and their elected representatives. To that end I commend "A Plan for Ontario Highways" to all members of the Ontario Legislature, to municipal authorities, and to the citizens of this Province.

Sincerely yours,

Jas. N. Allan.

James N. Allan,
Minister of Highways

jna:f

DEPARTMENT OF HIGHWAYS OF ONTARIO

HON. JAS. N. ALLAN, *Minister*

PRINCIPAL STAFF PARTICIPANTS

W. J. FULTON, *Deputy Minister*

PLANNING AND DESIGN BRANCH

J. WALTER, *Director*
K. H. SIDDALL, *Planning Engineer*
W. Q. MACNEE, *Traffic Engineer*
W. BIDELL, *Priorities Engineer*
H. A. MANTLE, *Location Engineer*
A. TOYE, *Bridge Engineer*
H. MCMILLAN, *Road Design Engineer*

STATISTICS AND ECONOMICS SECTION

P. E. WADE, *Highway Analysis Engineer*
C. R. HOPKINS, *Inventory Engineer*
R. B. TRUEMNER, *Planning Economist*
J. POMMERSBACH, *Highway Cost Analyst*

OPERATIONS BRANCH

W. A. CLARKE, *Chief Engineer*
C. TACKABERRY, *Maintenance Engineer*
FIVE REGIONAL SUPERVISORS
EIGHTEEN DISTRICT ENGINEERS

G. A. WELLS, *Information Officer*
J. G. MCMILLEN, *Financial Controller*

CONSULTING SERVICES

AUTOMOTIVE SAFETY FOUNDATION, *Washington, D.C.*

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FOREWORD

THE EXISTENCE OF an adequate network of roads and streets is of major importance to the economic well-being of Ontario. As traffic and other demands grow it becomes increasingly evident that many of our facilities are already inadequate and will become rapidly more so in the future unless the necessary steps are taken. Therefore, for the well-balanced development of Ontario's agricultural, industrial, recreational, mineral and other resources, as well as for the preservation of the vast public investment in a road and street system, it was recognized by the Department of Highways that the means must be found for developing and maintaining an adequate system.

As a first step the Department authorized the study of future needs on the major routes of the Province, the King's Highway System. These make up little more than one-tenth of the total mileage of roads and streets in the Province, but carry close to half the total traffic. They are the roads that Ontario most depends on for free-flowing channels of motor-vehicle transportation.

THE HIGHWAY STUDY

The Department of Highways in its recent reorganization set up a Planning and Design Branch. In May of 1955, its first Director (now Deputy Minister of the Department), Mr. W. J. Fulton, decided to conduct a comprehensive survey of the future requirements of the roads for which the Department was responsible, that is, of the rural King's Highway System, the Secondary Roads and the sections of King's Highways in towns and villages of 1,000 to 5,000 population.

The study was made the responsibility of the Department. The operations of the survey and the production of the report were under the direction of the Statistics and Economics Section of the Planning Division. The Department also obtained the services of the Automotive Safety Foundation, of Washington D.C., a non-profit organization devoted to the development of safety and efficiency in highway transportation. Their long experience in the carrying out of such needs surveys proved of great value throughout the progress of the study.

The many different operations were performed by personnel from all Districts and Branches of the Department. Particularly concerned were: the maintenance and construction staffs from all Districts and personnel from all sections of the Planning and Design Branch. These persons, throughout the many months of the study had, in addition to their regular duties, the responsibility of carrying out the collection and analysis of the vast amount of information required.

Valuable advice and cooperation were received also from other agencies and organizations, including the Department of Economics of Ontario, the Canadian Good Roads Association, the Automotive Transport Association, and the Canadian Pacific and Canadian National Railways.

SCOPE OF STUDY

The engineering analysis consisted of the following phases:

- Study of the service performed by highways for agriculture, industry, and commerce within the Province of Ontario.
- Review of the historical development of roads in the Province, including highway legislative, administrative, and fiscal policies.
- Study of the highway use characteristics, the selection of an adequate King's Highway sys-

tem, and the designation of these highways into classes.

- Analysis of the past and probable future use of Ontario highways in terms of traffic volumes and traffic patterns.
- Determination of tolerable physical standards for existing roads and bridges, and of appropriate standards of construction.
- Measurement of accumulated deficiencies in the existing highway plant, by means of a complete physical inventory, and preparation of cost estimates for required improvements on the basis of the appropriate construction standards for each class of road.
- Determination of general location and design of major new highway projects to serve future traffic demands.
- Determination of annual replacements required, as tolerable roads and bridges wear out.
- Determination of annual maintenance needs.
- Formulation of alternative, long-range programs for construction, replacement and maintenance of roads and streets.

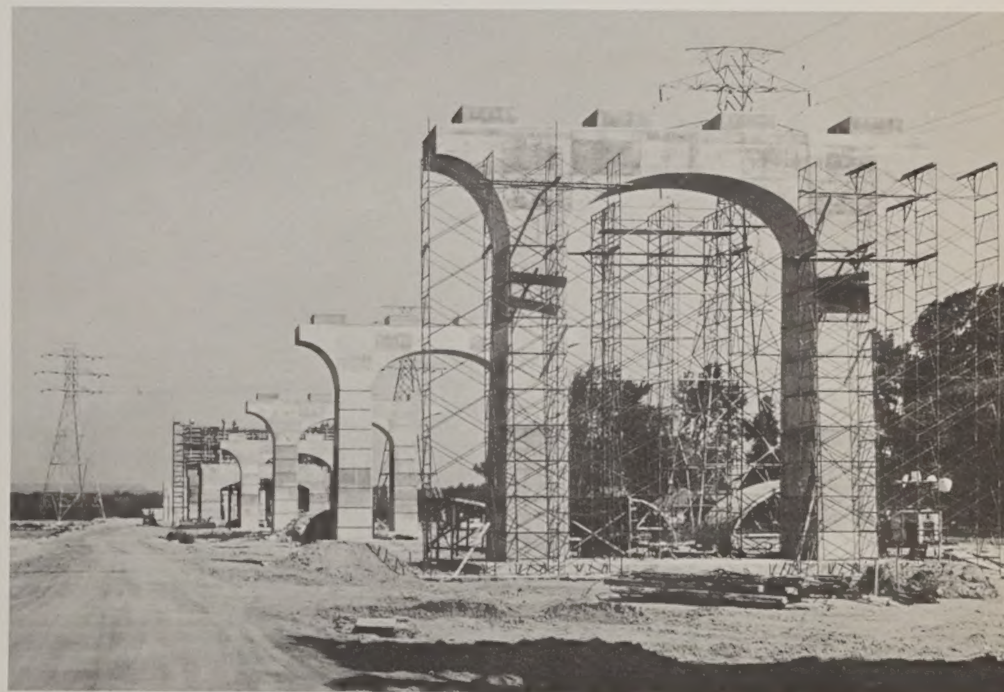
PURPOSE OF STUDY

Presented here are the 10-20 year future highway needs of Ontario, based on the physical conditions that existed on April 1, 1956. It is hoped that the present report will provide the basis for a systematic, long-range planning of highway activities in Ontario, and assist in establishing effective fiscal and legislative policy for highway development by the Government of Ontario. At the same time it should reveal to the people of the Province how essential it is that support be granted to the policies that the Government of Ontario will have to follow in order to bring about the necessary development of their highways.

FURTHER STUDIES

It is anticipated that as conditions in the Province change, fresh appraisals of the problem will be carried out. This study, therefore, is only the first stage in a continuing process and the techniques and principles followed will be refined and repeated continuously to keep current the planning activity of the Department.

The pressing needs of other highways, roads and streets in Ontario, which come under the jurisdiction of the counties, townships, and urban municipalities, are also of prime importance in Ontario's plans. The Provincial Government bears a large share of the financial burden of these roads which constitutes a large part of Ontario's total needs. The Department plans therefore, to extend its needs estimating to these roads as soon as possible, and to conduct studies similar to the one described in the present report.



The $16 million Burlington Skyway is an example of the large-scale construction projects required to eliminate traffic congestion. When opened in 1958 this 1½ mile elevated highway will remove one of Ontario's worst bottlenecks.

SUMMARY

ONTARIO is experiencing the greatest surge of population growth, motor vehicle use and prosperity in its history. Since investment in improved road facilities has not kept pace with the needs of mounting traffic, however, the Province is faced with a highway problem of considerable dimensions. It should be met realistically and without delay, for the continued economic health of the Province depends on a sound solution.

There is a direct relation between the level of economic activity and the volume of highway travel. Increasing industrial, agricultural and mining output, as well as expansion of commerce and tourism, are all promoted by highway transport. In turn, they generate new requirements for better highway facilities. The higher standard of living and more leisure made possible by expanding production are reflected in increased motor vehicle ownership and travel.

This is strikingly borne out by the fact that in the past decade, motor vehicle registrations in Ontario soared 144 percent, reaching a record high of 1,600,000 in 1955. This number is expected to rise to 2,700,000 by 1965 and well over 4 million by 1975, when travel mileage will have nearly tripled.

Ontario's reliance on good roads is further emphasized in other ways. One is its strategic position with respect both to the rest of Canada and the United States. Another is the rapid trend of urbanization, since cities are the focal points of traffic generation and movement. Finally, the geographic distribution of people in the Province poses a unique problem in providing adequate transportation service. The densely settled southern region requires a closely-knit network of modern highways. At the same time, the widely dispersed population of Northern Ontario also must be served.

THE HIGHWAY CHALLENGE

Not only has road building in the Province failed to keep pace with needs for many years, but the backlog of highway deficiencies has been increasing more rapidly during the prosperous post-war period. As the present study shows, a total of 5,400 miles on the King's Highway System and Secondary Roads are seriously inadequate for today's traffic. To rehabilitate the highways of the Province to a satisfactory level of service — including new construction, replacement and stop-gap work on roads and bridges — will require expenditure of an estimated $1.9 billion over a 20-year period.

Moreover, it must be remembered that (though not within the scope of this report) large deficiencies also exist on other segments of Ontario's 82,000-mile highway, road and street network. The traffic congestion in many urban areas, for example, testifies to this fact.

These mounting inadequacies spell heavy losses to the public, not only in wasted time and fuel and excessive wear and tear on vehicles, but in life itself. Motor vehicle accidents have increased at an alarming rate, climbing from 17,000 in 1946 to 63,000 in 1955. In the same interval, annual traffic fatalities have increased more than 60 percent. Highway accidents in 1955 alone cost the people of Ontario the huge sum of $110 million.

Incentives for more and faster highway progress are, therefore, enormous.

PROBLEM OF FINANCING

Since the end of World War II, the Provincial Government has spent almost one-third of its total budget for highway purposes. Although special highway-user revenues have been increasing, the burden on the budget has been growing heavier due to a steady shift of mileage and fiscal responsibility from local to Provincial Government, larger municipal road subsidies, inflation, and the higher design standards required for the greater volumes and weights of traffic.

These facts point up the need for stabilizing the highway systems for which the Province is responsible, and for accurately measuring the future costs of development and maintenance of these systems. Only on such a basis is it possible to formulate firm fiscal policy calculated to meet present and future needs in an orderly and efficient manner.

THE BASIC PLAN

Hence one of the main steps in this study was to create a functional classification plan, grouping those routes that are properly the responsibility of the Province on the basis of service performed. With this plan as a foundation, a necessary degree of stability can be achieved in estimates, programs, finances and organization—granting that changed conditions infrequently may require minor adjustments. Moreover, it will facilitate the primary aim of insuring that the King's Highways provide a consistent level of service throughout the Province and its subdivisions.

The selected King's Highway System, totalling 8,600 miles, includes these three major classes:

(1) **Freeway Highways**—totalling 800 miles of the most heavily travelled routes, connecting metropolitan centres and serving as the backbone facilities for interprovincial and international movement. This class carries 32 percent of King's Highway travel on nine percent of the System mileage.

(2) **Trunkline Highways**—totalling 4,920 miles of routes handling relatively large traffic volumes and linking other big cities and important areas of the Province. This class carries 50 percent of the travel on 57 percent of the System mileage.

(3) **Feeder Highways**—totalling 2,880 miles of routes that, while not significant from the standpoint of system interconnection, provide a desirable level of accessibility to King's Highways in rural areas, and at the same time serve numerous smaller communities. Feeder highways carry the remaining 18 percent of the travel on 34 percent of the mileage.

APPRAISAL OF NEEDS

On the basis of this proposed system, plus other roads and streets for which the Province is now responsible, a factual engineering appraisal of needs was prepared. The backlog of existing deficiencies was determined by evaluating highways, roads and streets against standards in line with experience and conditions found in Ontario. Deficiencies accruing within the next 20 years were determined with reference to estimates of traffic growth and the service life of present facilities. No road now affording at least tolerable service was listed as currently inadequate.

The analysis revealed that of the 8,600 miles of King's Highways, 3,800 miles or 44 percent should have immediate improvement. A total of 2,390 miles, for example, was found deficient in surface condition. Lack of even tolerable capacity on 700 miles is resulting in jammed traffic. Insufficient shoulder width on 1,770 miles constitutes an accident hazard and limits driving efficiency.

Of the 1,284 bridge structures on the King's Highways, 380 or 30 percent are deficient in point of width or load-carrying capacity.

As for Secondary Roads, fully 60 percent of the existing 2,400 miles are intolerable for reasons of insufficient width or poor surface condition.

COST OF IMPROVEMENTS

It was stated previously that capital needs through 1976 — on the classified King's Highway System and other roads under provincial jurisdiction — add up to $1.9 billion. Of that amount, $782 million would go for backlog work needed now on 5,400 miles. Including maintenance and administration, the aggregate cost is $2.7 billion, at 1955 price levels; municipal subsidies are not included.

Some 16 percent of the aggregate costs, including maintenance, is for Secondary Roads and other roads for which the Province is responsible.

About 60 percent of King's Highway construction costs are related to construction of 1,820 miles of multi-lane highways that should be built within 20 years. More than 620 miles of them are sorely needed now. It should be noted, however, that 75 percent of the King's Highway System will still remain two-lane roads in 1976.

Especially significant is the fact that King's Highway System total costs average 0.88 cent per vehicle mile over the future 20-year period, as compared with 1.3 cents in the past 18 years; per vehicle costs would total $36 annually, as compared with $46 in the past.

ALTERNATIVE PROGRAMS

Naturally it is desirable to eliminate the accumulated highway deficiencies as soon as possible, but it would be wholly impractical to attempt to get the job done in a year or two.

Rather, the catch-up work must be spread out over a period of years, during which new needs will arise from increasing traffic demands and the wearing out of pavements. During this time, too, maintenance and administration will continue.

As a basis for legislative decision as to how fast it is feasible to carry forward the work contemplated in this report — and how much money should be spent each year — three alternatives are suggested: a catch-up period of 10 years, another of 15 years, and another of 20 years, as shown in the summary table that follows.

Over 20 years, total expenditures would be nearly the same whichever program was selected, but of course the valuable benefits of improved roads would be available much sooner with a shorter catch-up period. Best for the Province would be the 10-year period. That means accelerating annual expenditures above the 1955/56 level of about $121 million (including Federal Trans-Canada share) would be desirable and necessary. None of the figures includes any estimate for municipal subsidies, nor for recent construction agreements with certain cities.

ANNUAL COSTS OF ALTERNATIVE PROGRAMS

(thousands of dollars)

	CATCH-UP PERIOD		
	10 years	*15 years*	*20 years*
Rural King's Highways	149,162	125,891	112,545
Urban King's Highway Sections	3,996	3,183	2,867
Secondary Roads	30,275	24,544	21,510
Totals *(per year)*	183,433	153,618	136,922

PRIORITY PROGRAMS

The engineering appraisal has marked out the broad outlines of a long-range highway program and has developed a general plan for specific road improvement. Further, by arraying backlog projects in order of rated adequacy and cost of improvement, it has provided a systematic, uniform basis for determining projects of greatest urgency. In this way, short-term work programs have been obtained.

In conclusion, this report makes available for the first time a true picture of the costs, present and future, entailed in the proper development and maintenance of a logically selected system of King's Highways and of other roadways of direct provincial responsibility. It furnishes a sound guide for action needed to attain the highway adequacy essential for a dynamic economy.

THE CHALLENGE

CHAPTER ONE

ONTARIO IS EXPERIENCING the greatest growth in population and economic activity in its history. With this growth has come a rapid expansion of motor vehicle travel, which is imposing severe strains on the Province's road network. A great deal of work must be done immediately to eliminate deficiencies that have accumulated in the past. The future will bring increasing demands for highway development.

Efficient road transportation speeds the growth of all forms of business, industry and agriculture, a growth that in turn calls for more and better roads. The present status and future prospects of all elements of the economy are factors that must be considered in planning the development of Ontario's highway system. They are the subject of the present chapter.

POPULATION

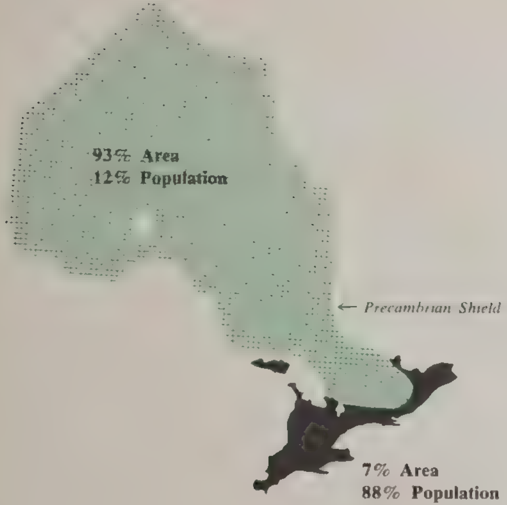
Throughout the last half-century Ontario has had about one-third of the population and 37 percent of the labor force of Canada. Today 5,200,000 out of Canada's 15,900,000 people live in this Province. The rate of population growth in recent years has exceeded that of the rest of Canada and has been nearly double the United States' rate. The fact that during the last 10 years 636,000 immigrants, 52 percent of the total for Canada, chose the Province as their home, shows that Ontario is widely recognized as a land of opportunity.

It is anticipated that Ontario's population will exceed 6.5 million by 1965 and will reach 8.2 million by 1975, an increase in the next 10 years of 25 percent, and of 58 percent over the next 20 years. Such rapid increases in population will in themselves create new demands for road services. Due allowance had to be made for them in the highway needs estimates.

Another factor affecting highway development is the unmistakable tendency for more and more people to live in cities and towns. This trend has been far more pronounced in Ontario than in the rest of Canada; in fact, evidence suggests that Canada as a whole was only reaching the stage of urbanization in 1951 that the Province had attained 20 years earlier. At present, two-thirds of the population of Ontario lives in centres of over 10,000; Metropolitan Toronto alone accounts for one quarter of the provincial total. From 1941 to 1951 urban population increased 25 percent, while the number of rural people increased at only half that rate.

There are 48 cities and towns in Ontario with more than 10,000 people. Thirteen have more than 50,000 and Metropolitan Toronto has a population of more than 1,300,000. Some 40 percent of Ontario's population and 73 percent of its manufacturing capacity are concentrated in an area of only 2,000 square miles, which is one half of one percent of the area of the Province.

The trend towards urbanization, which can be expected to continue, causes its own transport problems. Cities are focal points of traffic generation and distribution. As marketing centres they draw on large areas for supplies of food and raw materials carried by motor vehicles. As centres of production they provide surrounding regions with a constant flow of finished products. Large towns also create a substantial amount of tourist traffic, a factor that will be discussed later. Further, the



greater the size of neighbouring urban centres, the greater is the social and economic interchange between them and hence the interurban traffic volume that has to be provided for.

Finally, the geographical distribution of people in Ontario poses unique problems. The densely populated southern region with its concentrated, large traffic volumes requires, and can support, a closely-knit network of modern highways.

Yet the population widely dispersed over the vast and mostly empty lands of Northern Ontario must also be provided with at least a minimum of road services. Great distances separate the existing centres; for example, the road mileage between Kenora and Ottawa is 1,250 miles. The severe climate, the thinness of the soil cover over the hard granitic rock, the profusion of rivers and lakes that have to be skirted — all these circumstances create exceptional road-building difficulties in the north country. In many cases settlement and economic development follow directly the establishment of new routes. Expenditures on road construction in the northern regions of Ontario may therefore be regarded partly as an investment in the future.

ECONOMIC GROWTH

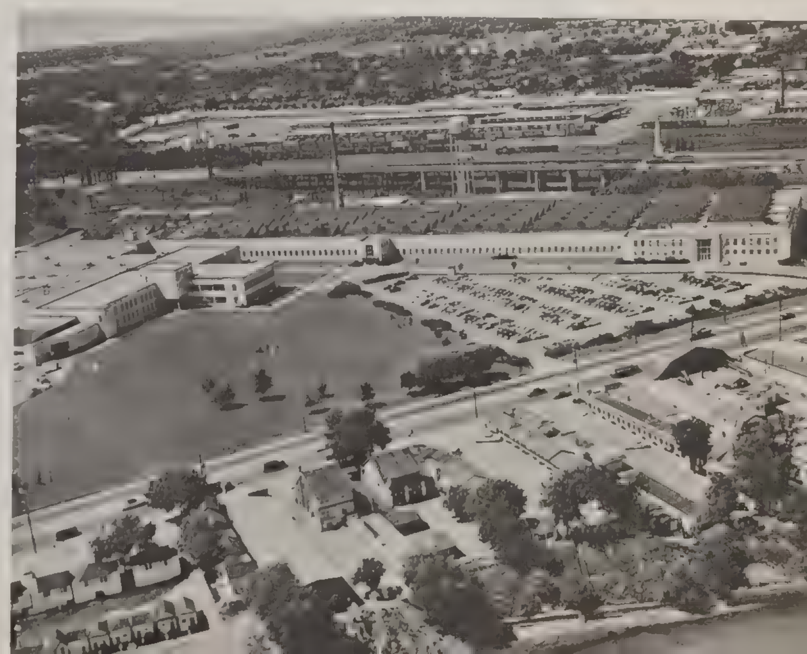
There is a direct relation between the level of economic activity and the volume of road travel. Increasing industrial and agricultural output, promoted by efficient highway facilities, in turn generates new demands for road transport services. Higher personal incomes, greater wealth and more leisure time — made possible by expanding production — result in still more travel.

MANUFACTURING

In 1954 the factories of Ontario, with a net value of production of $4 billion, accounted for half of Canada's industrial production. Ontario produces virtually all the motor vehicles made in this country, almost all of the heavy electrical machinery and agricultural implements and roughly three-quarters of Canada's primary iron and steel, rubber goods, radio and television sets. With a net value of production amounting to $279 million in 1954, motor vehicles and parts held first rank in Ontario's manufacturing output, followed by pulp and paper ($186 million) and non-ferrous metal smelting and refining ($173 million).

Many factors account for Ontario's evolution as the industrial giant of Canada. Among them are an abundance of raw materials and cheap hydro electric power, a strategic location relative to the rest of Canada and to the United States, and the suitability of land, soil and climate. But of prime importance has been the presence of a compre-

Modern industry locates close to top class highway facilities. Industrial supplies are moved by truck and employees motor to and from work.



hensive and efficient network of water, rail, highway and air transportation routes.

The increasing diversification of industry in Ontario is of great importance in shaping traffic patterns. Originally raw materials, such as forestry and mining products, predominated. Water carriers and railways were best able to handle these bulk goods at low cost. Now an extensive and vigorous secondary industry, producing a wide range of finished products, has developed. The net dollar value of manufactured goods in Ontario increased 7.5 times between 1925 and 1953; by contrast, mining output merely doubled; the value of agricultural produce increased 1.5 times and forestry production remained virtually unchanged.

The expansion of Ontario's highly complex manufacturing industry was greatly helped by the large-scale utilization of motor vehicles. The typical modern factory producing consumer goods is located near good highway facilities, away from densely settled residential areas. The plant draws on a large surrounding area for its supply of labor. Most of its employees come to work by car, often from as far afield as twenty or thirty miles.

Materials necessary for the production process are usually delivered to the factory by truck, with some bulk supplies hauled by water or rail for part of the journey. Finished products are again collected by truck and dispatched to markets in Canada and abroad.

The manufacturing plant itself forms a link in an intricate chain of economic and technical processes, which begin with the production of raw materials and end with the delivery of the finished products to the final consumer. Road transport performs the indispensable service of integrating the various stages of these geographically widely dispersed "assembly lines" of modern industry. With their fast, reliable door-to-door service, combined with great flexibility of routing and timing, commercial motor vehicles make possible continuous production, speedy marketing and substantial savings through reductions in inventories.

In this way road transport has become an integral part of industrial production. It is in the interest of the people of Ontario to facilitate by imaginative road planning and development further growth of manufacturing in the Province, for it is in large part upon progress in this field that rising living standards depend.

AGRICULTURE

Another major element in the Provincial economy — agriculture — still ranks high in terms of value of production. Farming is carried on predominantly in the southern parts of the Province, where climate, land forms and soils are generally favorable. The bulk of Ontario's farm income is derived from livestock and livestock products, which provided, in 1954, 74 percent of a total cash income from farm products of $705 million.

From southwestern Ontario come huge shipments of livestock, 90 percent of them by truck. From the same area, as well as from the easternmost counties, come milk and milk products. The Niagara Peninsula is one of the great fruit producing areas on the continent, whereas Ontario's egg and poultry farming region is located near the shores of Lake Huron. The bulk of these products — over 70 percent in the case of fruits and vegetables — is shipped by truck.

With urban residents comprising almost three-quarters of Ontario's total population, town and city consumers in the Province provide the dominant source of demand for farm produce. Production for the domestic market is increasing in

The distribution of the growing areas of agricultural products that are transported mainly by truck illustrates the wide-spread need for highway service. The solid color represents areas of greatest productivity.

relative importance and now overshadows production for export. As a consequence, external means of transportation become less vital, whereas the internal road network is subjected to ever greater pressure. From the widely separated agricultural areas, the great variety of farm produce is channelled toward the cities.

In addition to an extensive and complex retail organization, a great secondary industry comprising slaughtering and meat packing, flour milling, cheese and butter making, and canning of fruits and vegetables, is based on farm supplies.

Together, industries processing Ontario's farm products were responsible in 1953 for almost one-fifth of the value of all manufacturing shipments in the Province. From the cities, in turn, agricultural machinery, metal goods, feeds and fertilizers are sent back to the farms. The marketing of farm goods makes an important contribution to the industrial life of the Province.

MINING AND FORESTRY

The location of much of the road network in Northern Ontario reflects the importance of mining. New discoveries in now empty areas foreshadow the construction of roads where there are none today. Extensive road networks have grown up in the gold fields of the Timiskaming-Cochrane region and in the base-metal area of the Sudbury basin. New ore discoveries have brought roads to Red Lake, Atikokan, Pickle Crow and Manitouwadge. The uranium finds near Blind River will give rise to still other roads.

The construction of new roads in the north, brought about by important ore developments, has made economically feasible the exploitation of lesser ore bodies in the vicinity. Highway 120, newly constructed to the Atikokan iron finds, has facilitated the development of the Kashabowie copper deposit. Thus the exploitation of the mineral resources of the Precambrian Shield, which provided the largest part of $578 million worth of mining production in Ontario in 1955, has opened areas to motor transport that otherwise would have remained empty. Construction of these highways has enabled further development. There is no doubt that this process will continue.

The forest industry has had a less noticeable effect on the highway network than has any other factor in the economy of Ontario. Though activi-

Each year thousands of campers travel over King's Highway Number 60 to visit this campsite in Algonquin Park.

ties in the forests are probably more dependent on waterways than on roads, the towns the industry gives rise to, where timber is converted into lumber and newsprint, do need highway access.

TOURISM

It is difficult to obtain a sound estimate of the money value of tourism to the Province. It may amount to $200 million annually; it may be half as much again. But no matter what the figure may be, any realistic appraisal of present and future demands for road services must take into account the great importance of recreational travel.

The most striking development in tourism has been its democratization. In earlier days only the well-to-do could afford to travel long distances from their homes and stay for extended periods of time in resort areas. Today everyone has the opportunity for such activity and almost everyone takes advantage of it. Relaxation at the cottage, fishing and canoeing trips, water sports, weekend trips to the country, pleasure travel, have become generally accepted parts of our way of life.

Also of great importance to economic activity and travel in Ontario are the many millions of American citizens who live close to the Canadian border, in the most densely populated part of the United States. Some 20 million Americans visited Ontario in 1955 — about 60 percent of the total for Canada — all but a few in private cars.

Recreational travel creates particularly baffling problems for road planning because of its extremely unbalanced nature. There is much more traffic on the routes leading to Ontario's resort areas during the summer than there is during the winter. Furthermore, on weekends traffic is markedly heavier than on weekdays. But most important is the desire of hundreds of thousands of city dwellers to leave town on Friday evening and Saturday and to return on Sunday night. The cumulative effect of these factors creates traffic peak problems of staggering proportions.

To give one example: on Sunday, July 10th, 1955, between 8 p.m. and midnight, only 720 motor vehicles travelled northwards on Highway 400 from Toronto towards Barrie, but 12 times as many vehicles, a total of 8,700, travelled in the opposite direction. This is in marked contrast to the general experience on most other routes where the peak volume of traffic going one way is usually not more than twice as high as that in the opposite direction.

Such situations are by no means restricted to Highway 400 but can be observed on routes near all larger cities in Ontario. This poses particularly difficult problems for the highway planner, for the high volume of traffic crowded into a few hours a week makes it essential that recreational roads be designed to the highest standards. At the same time it has to be borne in mind that the predicted trend towards higher personal incomes and shorter working hours in Ontario and the consequent desire for more recreational travel, will cause greatly increased pressures on the road network.

GROWTH OF TRAFFIC

Every single factor discussed so far points to the conclusion that the future will bring further large increases in motor vehicle traffic in Ontario. It is significant that, as far as can be foreseen, not one of the general environmental influences will tend to retard the growth of travel, provided road development keeps pace with it. It remains now to assess the demand for highway services in the years to come and to indicate the magnitude of the road problem.

PAST TRENDS

During the last decade the total number of motor vehicles registered in Ontario has increased by 144 percent, to reach a record high of 1,600,000 at the end of 1955. In 1945 there were only 164 vehicles per 1,000 persons in Ontario. At the end of 1955 there were 310 vehicles per 1,000 persons.

Commercial vehicles have grown in numbers at an even faster rate than automobiles. Passenger cars increased 2.33 times from 1945 to 1955, whereas commercial vehicles increased 2.87 times. At the end of 1955, commercial vehicles of more than ten tons gross weight numbered 25,050, less than two percent of all motor vehicles. However, they were 14 times as numerous as in 1945, and have increased over seven times as fast as all other commercial vehicles.

Furthermore, the mileage travelled by the average motor vehicle in the Province has increased over the years. Whereas in 1938 the average annual mileage per vehicle was 7,760, it rose to 8,903 miles in 1955.

The highway system of Ontario has therefore been subjected to increasing pressure exercised in three ways; through fast growth of all vehicle registrations, through increasing numbers of heavier vehicles and finally through more mileage travelled by all vehicles.

ONTARIO'S ROADS

Under the tremendous impact of dynamic traffic growth, how have Ontario's roads been developed? The Province has now more than 82,000 miles of roads including everything from freeways to village streets. In terms of mileage, with certain exceptions for future development, the Province's network of roads and streets can be regarded as being sufficient. The real problem lies in improving existing facilities to modern standards.

Roads with permanently paved surfaces increased from 10,600 miles in 1945 to 15,400 in 1955. Paved mileage now accounts for 19 percent of the total, as compared with only 14 percent 10 years ago. Since the end of the last war, 170 miles of four-lane highways have been built.

As traffic increases, more and more delays occur, causing costly time losses to motorists and industry. This happens even on multi-lane highways, as at this location on the Queen Elizabeth Way.

So rapidly has traffic increased, however, that even these substantial improvements have made only small inroads upon the backlog of deficiencies that have arisen in the past, especially during and since World War II. No data are available to show the magnitude of the road problem as it already existed in Ontario, say, 10 or 20 years ago. However, there is no doubt that not only has road building patently failed to keep pace with traffic growth, but that the situation has progressively deteriorated during the post-war period. The present study will show that, of the 8,600 miles of King's Highways, 3,800 miles, or over 40 percent are considered intolerable. On 700 miles this is due to traffic congestion, on 3,100 miles to inadequate surfacing and other factors, such as bad curves and insufficient sight distance.

The rural sections of the King's Highway System carry almost 42 percent of Ontario's total traffic on only 10 percent of the total mileage of highways, roads and streets in the Province. The shortcomings of this system are therefore of prime significance to most people. It must not be forgotten, however, that deficiencies exist on the rest of the network too. They present a particularly critical problem in urban areas.

CONGESTION AND ACCIDENTS

As a result of the "lopsided evolution" of traffic relative to road improvement, almost all principal highways of Southern Ontario suffer from moderate to extreme congestion. Great losses through waste of time, fuel, and unnecessary wear and tear of vehicles, are the final result. It is difficult to assess for Ontario the economic losses caused by the inadequacy of the road system, but one typical example shown in the accompanying box, will serve as an illustration.

Another serious consequence of the fast growth of traffic in the Province is the rising number of

IMPROVED OPERATING COSTS

Some indication of the decrease in operating costs brought about by replacing congested highways with four-lane divided facilities was obtained by measuring vehicle operating conditions on each during periods of peak traffic. A station wagon was driven over a total of 169 miles of four-lane divided highway and a total of 174 miles of mostly two-lane highway on parallel stretches of these highways connecting the same geographic locations. The following comparison was obtained.

Four Lane Divided Highway (controlled access)
Two Lane Highway (unlimited access)

	Two Lane ↓	Four Lane ↓
Distance (between same points)	174	169
Driving Time (minutes)	287	190
Average Speed	36.4	53.5
Brake Applications	139	19
Stops (traffic lights)	23	0
Stops (other than traffic lights)	22	0
Gear Shifts	64	0
Gas Consumption (gallons)	8.7	8.9
Cars Passed	123	226
Cars Passing	35	128
Daily Traffic Volume (in study period)	9,000	17,000

These results compare existing conditions on the new and old highways, but do not actually measure the improvement over conditions on the old route before the new highway was opened. Such results, if available, would indicate an even greater benefit.

All of the above characteristics affect tire wear, oil consumption, vehicle maintenance and repairs, depreciation and other driving costs. It would be difficult to determine actual costs from the test results. However the American Association of State Highway Officials has estimated costs for different road and traffic conditions. Their estimates for the conditions of the test show an operating cost for automobiles of about nine cents per mile for the two-lane road and about seven cents per mile for the four-lane highway. *This demonstrates a saving of about two cents per vehicle mile from the operations on a four-lane divided, controlled access highway over a congested, two-lane highway.*

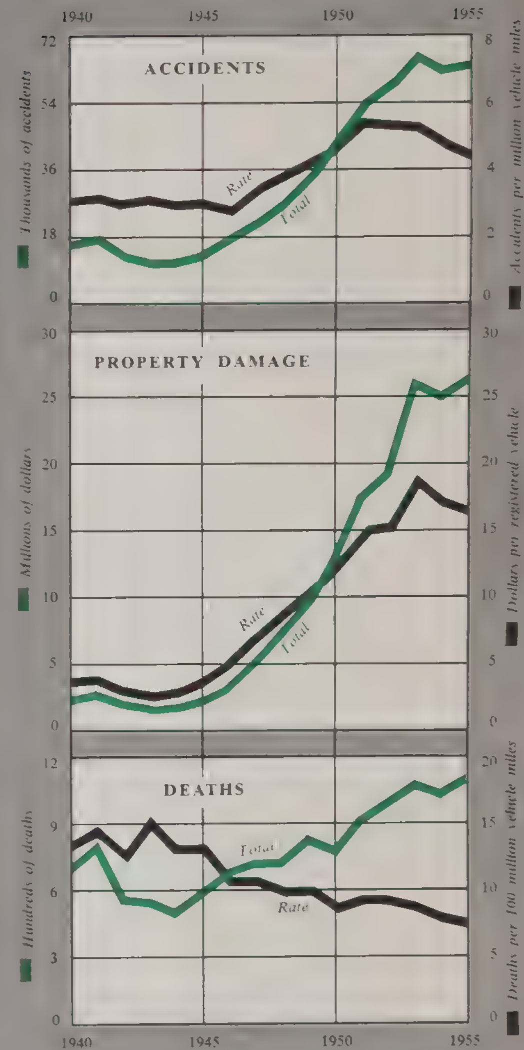
accidents. The total number of traffic accidents recorded in Ontario showed an alarming increase from 17,356 in 1946 to 63,219 in 1955. During this time, traffic fatalities almost doubled, from 688 deaths 10 years ago to 1,111 during 1955.

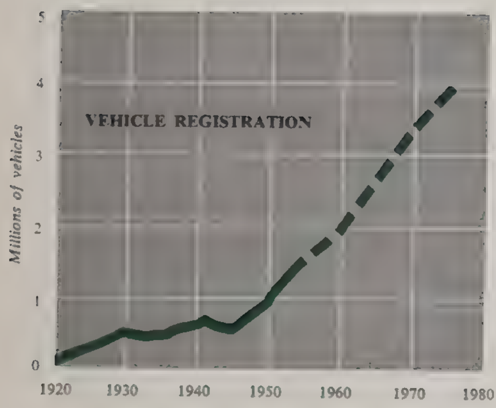
While the total number of traffic deaths rose, motor vehicle travel grew even faster. Consequently, the "death rate", that is the number of fatalities per 100 million vehicle miles, has fallen slightly in recent years. This would indicate that some progress has been made in Ontario to arrest a further rise in the appalling flood of accidents in relation to travel. However, Ontario's current death rate of 7.6 is still above the 1955 national average in the United States of 6.4. It is slightly lower than the Canadian rate of 8.0 in that year.

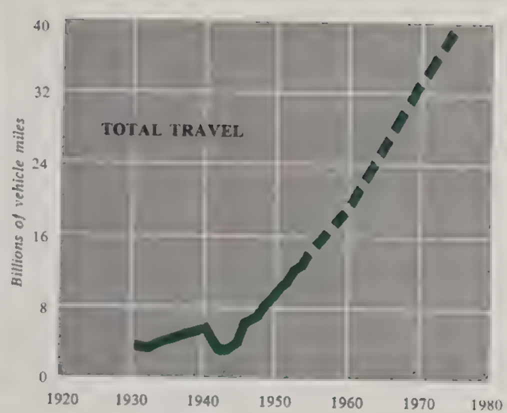
Direct property damage alone, caused by traffic accidents in Ontario, amounted to $27 million in 1955. Estimates based on calculations of loss of earning capacity due to untimely death, hospital expenses, medical bills, etc. put the total traffic accident bill to the people of Ontario in 1955 at over $110 million. To this figure must be added the incalculable losses resulting from the unwarranted destruction of human life and health.

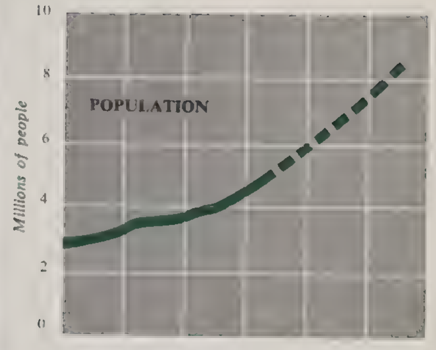
Studies in Canada and the United States have revealed that the accident toll can be reduced by as much as 25 percent through physical improvements of the highway system. Freeways, such as King's Highways 400 and 401, can cut the death rate to one-third or one-quarter that of ordinary four-lane roads. During the past year 17,720 traffic accidents, causing 592 deaths, occurred on the King's Highways. It follows that 150 lives could be spared annually, and that the number of accidents could be cut by 4,000, if the King's Highway System were developed to proper standards. If the King's Highways are brought to the level of efficiency advocated in this report, the economic savings from reductions in accidents alone may amount to $15 million a year.

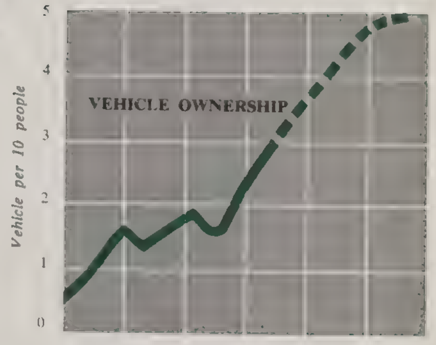
ACCIDENT INDICES











FUTURE TRENDS

In addition to past and present problems and deficiencies, road planning is vitally concerned with the future. If the expanding volumes of motor vehicle travel are not to overwhelm Ontario's highway facilities completely, it is necessary to estimate and prepare for future growth.

Highway travel depends on three basic factors: the number of people, how many of them own and operate a vehicle, and the number of miles that Ontario cars and trucks are driven in a year. In addition, travel trends are affected by movements of outside vehicles within the Province and of Ontario vehicles in other regions. The following forecasts for the next twenty years resulted from special studies of these factors:

Population: 6,500,000 in 1965, 25 percent more than in 1955; 8,200,000 in 1975, 58 percent more than in 1955.

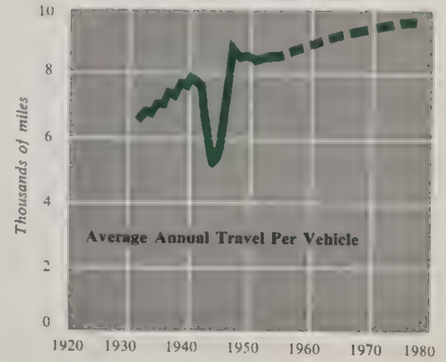
Ownership: 417 vehicles per thousand population in 1965 as compared with 310 in 1955, levelling off to 500 vehicles per thousand population in 1975.

Vehicles: 2,700,000 automobiles and trucks in 1965, and 4,100,000 motor vehicles in 1975, an increase of 69 percent in 10 years and of 156 percent in twenty years.

Travel Per Vehicle: 9,300 miles annually by the average vehicle in 1965, 4.5 percent more than in 1955; and 9,500 miles in twenty years, 6.7 percent more than in 1955.

Total Travel: 25.2 billion miles by 1965, 76 percent more than the 14.3 billion miles in 1955; 38.8 billion miles by 1975, 171 percent more than in 1955.

It is worth noting that these estimates of Ontario's traffic growth indicate a 20-year traffic increase of more than double the rate anticipated in any comparable study in the U.S.A. It is the purpose of this report to show the impact the tremendous growth of traffic will have on the King's Highway System, and to propose solutions that will restore its efficiency and develop it to standards adequate for future use.



ORGANIZATION AND FINANCE

CHAPTER TWO

TO MEET THE transportation challenge of a growing economy, Ontario has established specialized legislation, organization, intergovernmental relations, sources of revenue and policies of expenditure for highways, roads and streets.

Improvement in these matters has been the result of experience, the study of inadequacies as they developed and the periodic review of how best to meet future requirements.

The present chapter briefly reviews the important trends and present status of responsibilities and finances. When these factors are considered in relation to the target programs set forth in Chapter V, a basis is provided for the consideration of future policy for highway development.

Outstanding among the trends revealed by this study is the shift of direct control and financing of roads and streets from local to higher levels of government. To some extent, this is the inevitable result of the wider distribution and growing use of motor vehicles, calling for a broader responsibility in providing consistently good highway service throughout the Province. The financial responsibility of the Province continues to increase, partly because of the availability of province-collected motor vehicle and fuel taxes and partly because of the lack of local organization in Northern Ontario.

Increased cooperation between the Province and the municipalities results from the sharing of province-collected taxes and the need for integration of provincial and municipal highway systems — for the motorist uses both to complete most trips and is not concerned with the location of political boundary lines.

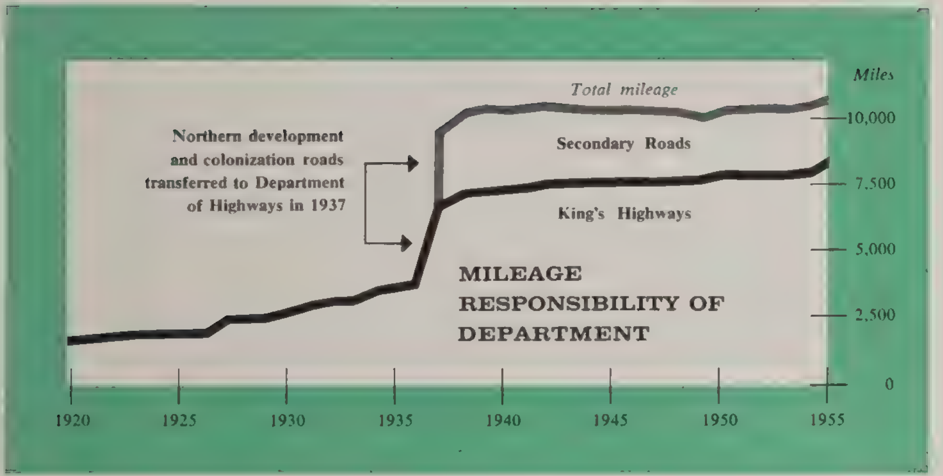
RESPONSIBILITIES

The responsibilities of the Ontario Department of Highways have grown from limited supervision and assistance on 1,600 miles in 1920, to its present complete responsibility for 11,000 miles of highways throughout the Province. The growth pattern is shown in the chart on the next page.

Establishment of the Department followed a detailed study of the road problem by the Public Roads and Highway Commission in 1914. The progressive ideas of this Commission quickly led to practical achievements.

In 1915 a Department of Public Highways was set up—the first of its kind in Canada. Subsequently a provincial road system was formally established under the Provincial Highways Act of 1917. The Lieutenant-Governor in Council, upon recommendation of the Minister of Highways, was empowered to "assume any highway in the Province and alter and repair it as he deems necessary." The most important of the 60,000 miles of highway existing in 1920, about 1,600 miles in all, were designated as Provincial Highways, with the Province paying 70 percent of road costs, the remaining costs being borne by counties and cities. In 1930 these roads, which then extended about 2,700 miles, were named "King's Highways" and five years later they became a wholly provincial responsibility.

To improve organizational efficiency, the northern development and colonization roads were placed, in 1936, under the authority of the Minister of Highways. Thus a single administrator was established for all provincial road activities.



By this measure, the length of the highway network was increased sharply from 3,700 to nearly 9,700 miles. In the last 20 years, the network has grown an average of about 63 miles annually, and is now composed of the roads shown in the map on page 22.

ORGANIZATION

Today, the powers and duties of the Department of Highways are governed principally by the Highway Improvement Act and its amendments. The Department employs 9,200 people in all its various Branches. In addition to those dealing with highway planning, design, construction and maintenance, the Department has these other Branches:

Motor Vehicles, whose responsibilities, governed by the Highway Traffic and other Acts, consist of the licensing of drivers and vehicles, tax collection, traffic regulation, and other duties;

Services, responsible for equipment, property, land surveys, permits;

Accounting, responsible for the bookkeeping and budgeting of the Department.

Highway operations are directed from the central office headquarters in Toronto and carried out by five regional offices and 18 district organizations. The scope of their duties is set by the extent of highway mileage for which the Department is responsible, and by the character of work authorized to improve and maintain the facilities for increasingly heavy concentrations of traffic.

LEGISLATION

The Highway Improvement Act has kept pace with the times by frequent amendments to provide the authority needed by the Department.

In general, the Act gives the Minister and the Department all the powers required to locate, plan, build, maintain and operate such rural highway facilities as the Lieutenant-Governor in Council, upon recommendation of the Minister of Highways, may select.

In addition, limited authority is granted the Minister to construct directly, or enter into agreements for cooperative construction of, certain city streets that are connecting links between sections of rural King's Highways. Such authority has been used sparingly and in varying degrees, mostly in smaller cities and towns that cannot themselves afford all the facilities required to handle heavy through traffic. The Province provides subsidies for street improvements and maintenance in all municipalities, as explained later.

The Minister also has the duty of issuing regulations governing the use of vehicles, such as weight restrictions, speed limits and other traffic control measures.

Among more important recent amendments to the Highway Improvement Act is one authorizing "controlled-access" highways. These are the most modern highways, free of traffic signals, crossroads and roadside buildings. Highways 400 and 401 are similar to such facilities built for moving high-volume traffic rapidly and safely between major areas.

INTERGOVERNMENTAL RELATIONS

A considerable part of the Department's activities and funds aid municipalities and unorganized areas in carrying out their own road and street improvement programs and maintenance operations. The Province pays subsidies for such work from provincial highway appropriations, under certain conditions set forth in the Highway Improvement Act and its amendments. In general, any expenditures for road or street purposes are approved, within budget limits.

Percentages of cost borne by the Province, and eligibility of various systems of roads and streets for such subsidies, have gradually increased over the years, as shown in the chart on page 19.

Highway problems have altered greatly since this photograph was taken. At that time the slogan most repeated was: "Get us out of the mud."

HISTORICAL PRECEDENTS

At the opening of the nineteenth century the provincial government began to give annual grants for road building, which otherwise had to be sustained by statute labor. These grants steadily increased from an initial £1,000 in 1804 to £100,000 during the years 1836-40, when they absorbed the greater part of the provincial revenues. During the same period, privately built toll roads became as popular in Ontario as in the United States and Great Britain. By 1841 there were about 6,000 miles of such roads in Ontario, but later they were taken over by municipalities or the Province. No toll roads and only a few toll bridges exist today.

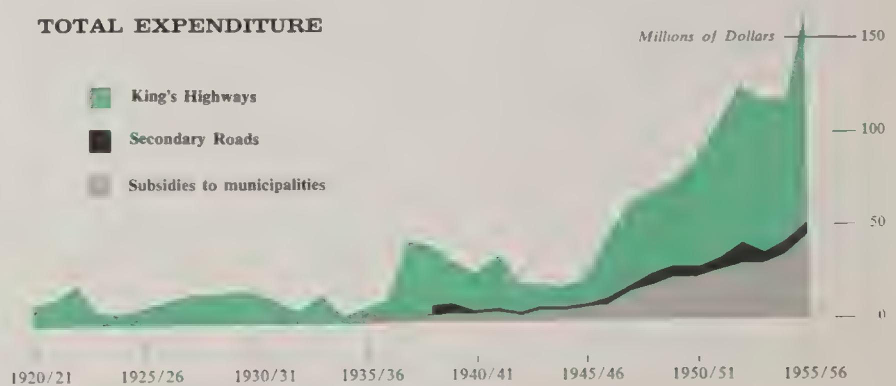
STAGNATION OF ROAD DEVELOPMENT

The 1840's saw development of municipal governments in Ontario which gradually assumed responsibility for local roads; main roads were retained under provincial administration. During the next decade the Province attempted to open up the back country on the Precambrian Shield by a system of colonization roads. On the whole these early roads were not a success and most of them were abandoned in time. The introduction of railways put an almost complete stop to further road construction. A long period of stagnation in road development followed, and resources were devoted to promotion of the new form of transportation. Even Canada's constitution, which emerged from Confederation in 1867, showed that at the time there was no national concern with roads.

THE AUTOMOBILE ERA

Two events mark the end of the "dark age" of road building in Ontario and the beginning of new activity: the founding of the Ontario Good Roads Association in 1894 and the appearance of the first automobile in Ontario four years later. The efforts of motorists and road enthusiasts, coupled with the growing transport demands of an increasing population and an advancing economy, resulted in a revival of public road building at the beginning of this century. Full responsibility, however, remained in the hands of municipalities.

At first, work on the large mileage of existing roads—considered necessary for land access—proceeded sporadically. But it was soon realized that there was need for a systematic approach to road development, so that preferential treat-



ment could be given to the more important portions of the vast highway network.

The 1914 legislative report, referred to earlier, began the modern era of cooperation between the Province and the municipalities. From that time on, not only did the Province accept greater direct road responsibilities, but also provided more financial aid for local roads and streets, as charted on page 19.

THE MUNICIPAL ROADS BRANCH

First established as part of the Department of Highways of Ontario in 1915, the Municipal Roads Branch now administers the legislation and funds that provide subsidies to about 1,400 counties, townships, suburban road commissions, cities and separate towns, Metropolitan Toronto, and unorganized territory. In addition, the Branch handles the Development Road and Sidewalk Construction funds. These latter projects are built by the Province and returned to the municipalities for maintenance.

The total amount of subsidies in the fiscal year 1954-1955 was $35 million — about 30 percent of the total expenditures of the Department, and slightly over 50 percent of the approved expenditures for construction and maintenance by local agencies of government.

The Municipal Roads Branch has staff engineers in all highway districts. By operational guidance and supervision in the field, coupled with advisory liaison between local governing bodies and the Department, the Branch provides the intergovernmental relations necessary to modern highway transportation.

However, responsibility for deciding what work will be done where, and when, remains entirely with the local municipalities. Thus, the subsidy funds required of the Province depend largely on the extent of approved by-laws and the amount of expenditure made at the discretion of local governments.

FEDERAL RELATIONS

An act of Parliament in 1949 authorized the only participation by the Dominion government in Canada's modern road-building program, aside from that on lands under Federal control.

The Trans-Canada Highway was established by agreement with the provinces. Ontario recommended the location of its portion of the Highway and the final selection, as shown in the map on page 22, was agreed upon with the Federal government. Ontario's portion totals 1,466 miles, running through Ottawa, along part of Route 7, and on to Orillia and Parry Sound, thence to Sudbury, Sault Ste. Marie, along Lake Superior and westerly to Manitoba.

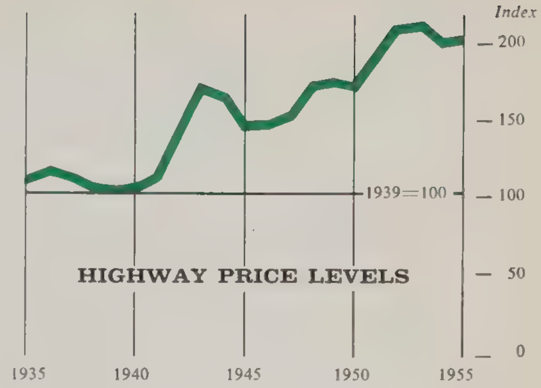
The Federal government establishes minimum standards of construction and, until 1956, contributed 50 percent of the cost. For uncompleted sections, the contribution was then increased to 90 percent. Maintenance remains the responsibility of the provinces. Through March 31, 1955, the Federal government had contributed $21,551,000 towards the work in Ontario—most of it on existing King's Highway routes. The estimated total cost of completing the Trans-Canada Highway in Ontario to the necessary standards is $132 million. This includes $32 million for 164 miles of uncompleted sections; the balance is for reconstruction of about 800 miles of existing highways.

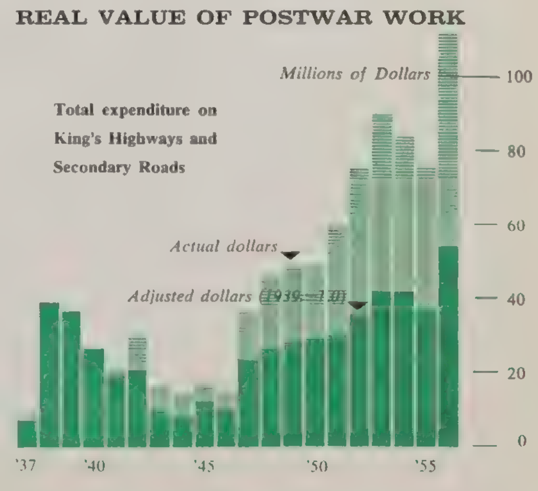
FINANCE

Highways are financed in Ontario by appropriations of the Legislature from the Consolidated Revenue Fund, into which go receipts from nearly all tax sources and special fees.

The Legislature tends to appropriate funds somewhat in proportion to the funds received from special highway taxes, such as on gasoline and motor vehicles. Over the years, however, there have been notable exceptions when appropriations were much less than the special revenues, and conversely, when annual highway budgets exceeded special highway tax revenues. In total, expenditures by the Department of Highways since 1915 amount to about $1.25 billion and receipts from highway taxes over the same period approximately equal that amount.

Increased tax rates coupled with growing numbers and use of motor vehicles have been responsible for greatly increased revenue since the end

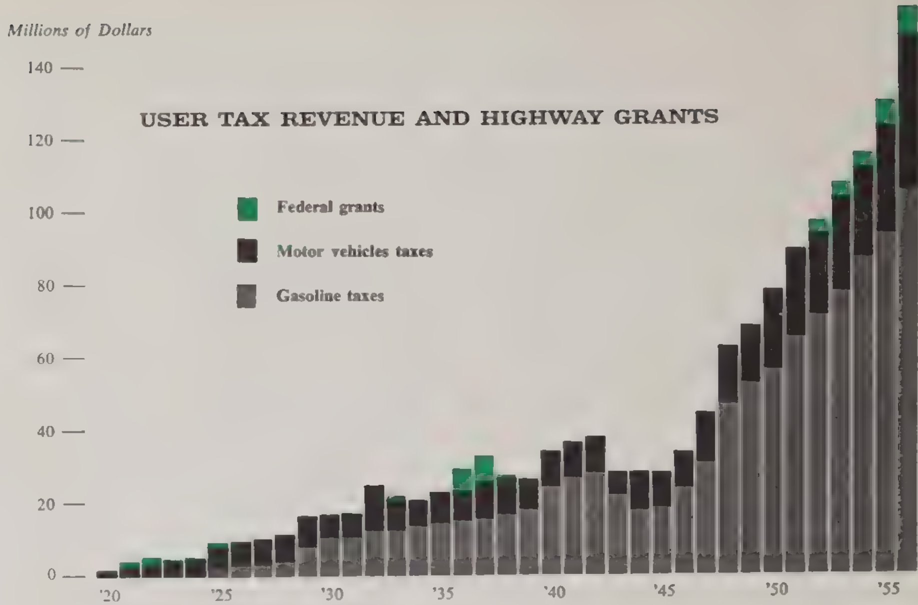




of World War II in 1945. Income in the last decade was 2.7 times that of the previous decade. But the need for improvement of highways to accommodate recent rapid growth has proven to be great, and inflation has cut the amount of work that can be done with a dollar.

Until now there has been no estimate of long-range needs on which to base fiscal policy, and the Department has done what it could with the available funds. Upon completion of the present report, the over-all needs for direct provincial expenditures are made known for future budget consideration.

Municipal subsidy requirements should also be based on a competent engineering analysis. Such an analysis, however, is beyond the scope of this report.



EXPENDITURES

The growing mileage of roads under complete provincial responsibility, plus increased subsidies to municipalities and the great need for improvement of all systems, has resulted in a new high in expenditures by the Department of Highways in the fiscal year ending March 31, 1956. It is estimated that $157 million was spent for all functions of the Department (excluding Federal share of the Trans-Canada Highway — see Appendix)

The chart on page 19 shows the changing pattern of expenditure, with low points marked by depression and war-time retrenchment when even maintenance was cut to a bare minimum.

PRICE LEVELS

Inflation has had its effect on highway costs, as on everything else. The upper chart on page 20 shows the level of average prices for highway work compared with those prevailing in 1939.

Wage rates and prices of materials and equipment have increased to an average of about double the 1939 figures. Some highway costs have more than doubled, but improved machinery and construction methods have helped to keep some prices down.

Prices are only one element of the increased cost of building modern highways. In addition, it should be recognized that the necessarily wider and better roadways and bridges involve more land costs, more materials and more work than formerly. As a result the cost of a mile of road in today's inflated dollars is more than twice that of pre-war days.

Thus, the dollars available for construction and maintenance do not stretch as far as they used to. Expenditure of $157 million in the fiscal year of 1956 bought only about $77 million worth of work in terms of 1939 dollars. The chart at the bottom of page 20 shows how much *actual* highway construction and maintenance was accomplished over the years on King's Highways and Secondary roads alone. Only three post-war years show gains over work done in 1938. It is obvious that the real value of post-war work is not nearly as impressive as the dollar expenditure would imply.

Costs of the proposed programs shown in Chapter V are based on 1955 highway prices. If prices continue to rise, costs will be greater or the program will have to be reduced. If prices decline, costs will be less or the work will be done sooner.

REVENUES

As pointed out earlier, there is no direct connection between budgeted appropriations or expenditures and highway-user tax receipts. But the amounts received from such sources do have a major effect on appropriations.

From small amounts at the beginning, revenues have continued to climb, with only short periods of decline in depression and war that have been more than made up by rapid increases in the post-war period, as shown in the chart on this page.

The chart also shows income over the years from gasoline taxes, licence and registration fees, and Federal grants. It will be noted that gasoline taxes have provided the largest share of the revenues, especially following the increase from eight to 11 cents per gallon in 1947. At that time the Province took over the Federal war-time tax that the Federal Government discontinued. In 1955 the gasoline tax provided 73 percent of revenues, although licence and registration fees have shown sharp post-war increases owing to the growing numbers of passenger cars and the even more rapid growth in the number and weight of trucks.

Following is a brief statement of major tax rates and revisions that have been partly responsible for the increased revenues.

Gasoline Tax (Per Gallon)

First introduced in 1925 at 3 cents

Raised to 5 cents in 1929
Raised to 6 cents in 1932
Raised to 8 cents in 1939
Raised to 11 cents in 1947

Vehicle Registration Fees (Current)

DEPENDING ON AGE AND H.P.

Passenger Cars	3.00 to $ 21.00

DEPENDING ON WEIGHT

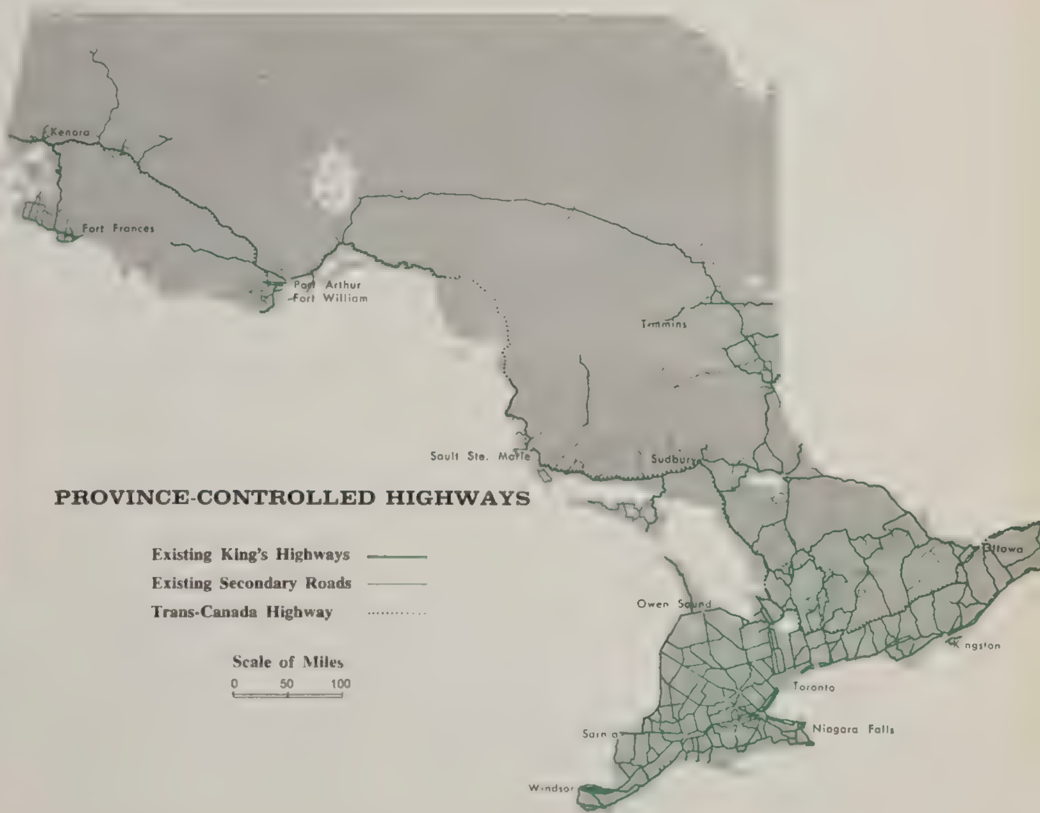
Commercial	10.50 to $502.00
Trailers	2.50 to $320.00
Buses ..	17.50 to $342.00
Dual Purpose	10.50 to $ 50.00

SUMMARY

Since the end of World War II, the Provincial Government has spent almost one-third of its total budget for highway purposes, including municipal subsidies. The proportion for highways has remained relatively constant for each year of the decade, and is about the same as for the pre-war years of 1937-1939.

The shift of mileage and fiscal responsibilities from local to provincial government, added to the doubled cost of doing work since the last war, have placed greater burdens on the provincial budget. At the same time, although special highway-user tax revenues have increased greatly, real values of work accomplished have failed to keep pace with the tremendous traffic growth.

These facts point to the need for stabilizing the extent of the highway systems for which the Province is responsible and for estimating the future costs of proper development and maintenance of those systems. These are the subjects of the remaining chapters of this report, which provide the basis for the development of a firm fiscal policy designed to meet the needs in the most feasible manner.



THE BASIC PLAN

CHAPTER THREE

As long ago as 1914 the Public Roads and Highways Commission of Ontario reported that, "The general classification of roads and their division into groups for control are matters of primary importance in dealing with public highways". Today, more than 40 years later, classification remains basic to sound highway administration.

NEED FOR CLASSIFICATION

The rural roads of Ontario are now classified more or less logically into three groups, namely:-

King's Highways	8,600 miles
County and Secondary Roads	11,700 miles
Township Roads	54,300 miles
Total Rural Roads	*74,600 miles*

Except for Secondary Roads, each class of roads is administered by a parallel class of government — the Province, the counties and the townships — and each has a different financing arrangement.

Secondary Roads under provincial control, totalling about 2,400 miles, actually are similar in function to county roads, but the Province handles them, ordinarily due to lack of county organization in the north.

The King's Highway System was originally established as a result of the Ontario Highways Act of 1915 and then totalled 500 miles. It has expanded to a present network of 8,600 miles, shown in the map on the opposite page.

Over the years numerous changes have been made in the classification (and thus the administration and financing) of various roads. Now the point has been reached where present and future planning of finances and road improvement call for determining what routes logically belong in each system, in order to have a fairly stable and fixed basis on which to develop programs.

This has been the *first object* of this study — to *develop a logical method of determining what routes should be King's Highways,* avoiding the inclusion of any that are like most roads in some other system. *The second object was to determine whether classes of King's Highways should be established for planning purposes, and if so, what routes should be in each class.*

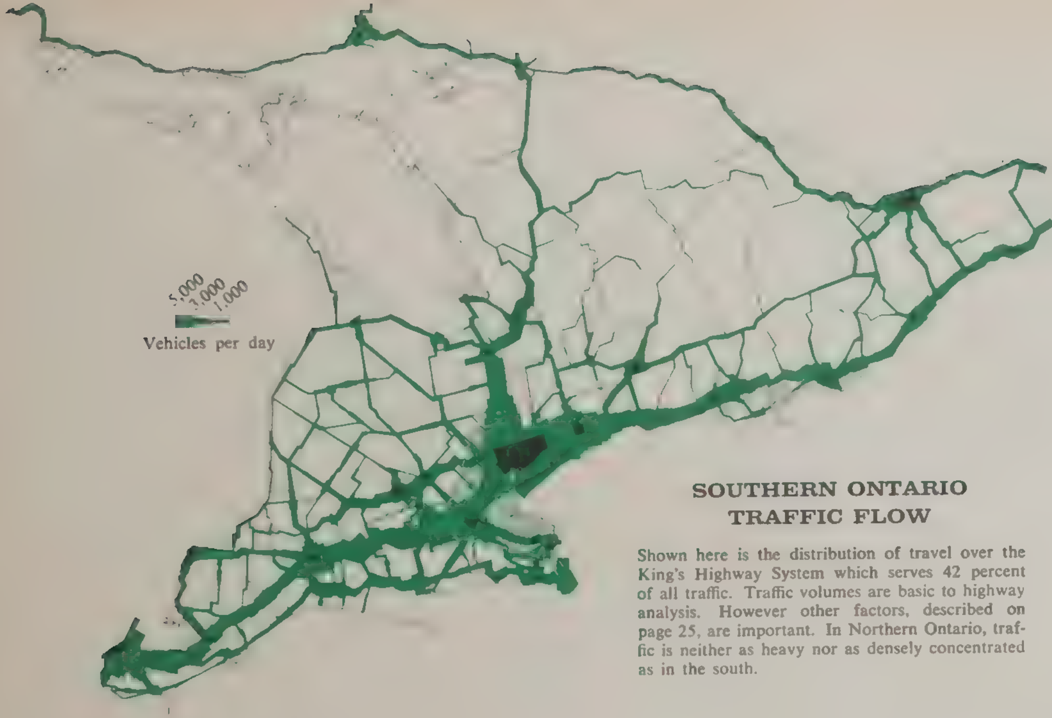
Later, it is the intention to carry out further studies, in cooperation with local governments, to determine proper classes of the remaining roads and streets.

BASIS FOR CLASSIFICATION

Highways have been classified in many different ways, as, for example, by width and by surface type. But none of these ways establishes what form of service is needed for the traffic demand on each highway. They merely record existing status.

What is needed is a method of determining the kind of service each route provides — that is, what function each performs in the transportation scheme. Research has provided such a method. It is called "functional classification", and it is the basis for system selection through a factual, engineering approach.

Functional classification isolates the real *purpose* of each road in serving people and traffic. It shows, for example, whether a road is of province-wide and interregional importance, serving vehicles



SOUTHERN ONTARIO TRAFFIC FLOW

Shown here is the distribution of travel over the King's Highway System which serves 42 percent of all traffic. Traffic volumes are basic to highway analysis. However other factors, described on page 25, are important. In Northern Ontario, traffic is neither as heavy nor as densely concentrated as in the south.

travelling long distances at high speeds; or of local importance, providing land access to short-haul, slower traffic; or a combination of the two, such as a county road.

BENEFITS

A good functional classification, backed up by facts and figures, provides many benefits, especially to the motorist, but also to the administering government agencies.

1. It enables each route to be controlled by the level of government most closely concerned with the type of service rendered by the route.
2. It provides the basic plan for assigning design, construction, maintenance, and traffic-control standards that are related to the type of traffic served by each route, and makes possible the consistent application of the standards to each class of highway.
3. It is a useful guide when determining the importance and order of priority of different highway construction projects.
4. It assists in establishing fiscal policies for future road improvement.
5. It enables the recording of highway statistics and information in a more logical and consistent manner.

CLASSIFYING KING'S HIGHWAYS

Very few roads offer service exclusively to one class of traffic. A local road may be used at the end of a long trip across the Province, and conversely, a main highway may be used for many short trips by persons living nearby.

For proper classification, the *predominant* use must be established and limits defined. This report is confined to setting such limits for the King's Highway System and investigating all routes that might qualify for this system.

KING'S HIGHWAY SYSTEM DEFINED

The King's Highway System should be limited to those routes that are clearly of province-wide interest and for which the Province should accept full financial and administrative responsibility. Provincial control of highways is warranted when the Province is the agency that can best provide the interconnecting facilities for traffic with origins or destinations beyond local areas. Such traffic tends to collect on certain roads and follow the shortest and best routes.

Thus the King's Highway System should consist of those collector roads that carry relatively large volumes of interregional traffic, offer the shortest routes between major points of traffic interest and can interconnect all such places with reasonable service to more widely distributed population in rural areas.

FACTORS IN CLASSIFICATION

Consideration of the proper function of a King's Highway System, and comparison with similar systems elsewhere, have shown that existing King's Highways have been reasonably well selected and that no major revisions are required. *The principal problem has been to ensure that the King's Highways provide a consistent level of service throughout the Province.*

The general factors involved in measuring the consistency of route service and in identifying important classes of King's Highways, are listed in the following paragraphs.

Traffic volume on a road is one of the major

factors that indicate the function and importance of the road. But it is not the sole factor. One of the purposes of a classification study is to analyse other highway service and traffic characteristics that also indicate the importance and function of a highway.

The following six characteristics:

- Traffic Volume
- Intercentre Service
- Through Traffic
- Highway Accessibility
- Land Use and Service to Natural Resources
- Integration and Circulation

were used as the basic factors in selecting the routes that should make up a proper King's Highway System.

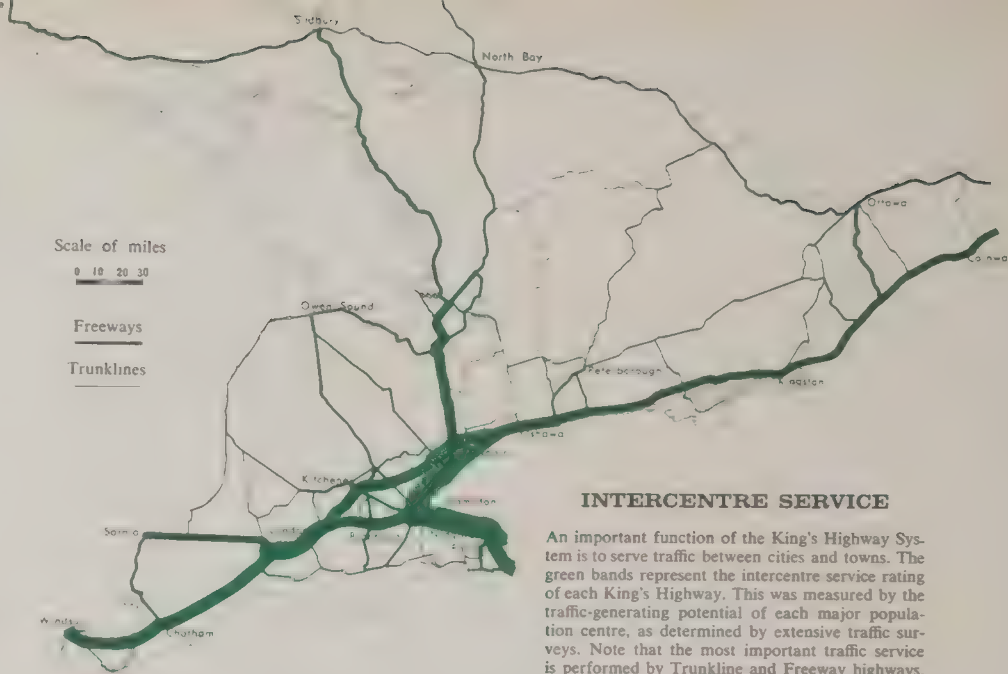
Data were developed for each existing route; limits were established by careful analysis of all routes and then each road section was tested against those limits. In addition, other roads were studied to determine whether any might qualify for inclusion in one of the classes of the King's Highway System. Finally, maps were reviewed to make sure that all routes were integrated for adequate traffic circulation and directness of service.

These steps are best illustrated by review of the study results, shown later in the chapter.

SEPARATE STUDY OF SOUTHERN AND NORTHERN ONTARIO

In the classification study it was necessary to treat Southern and Northern Ontario separately, owing to differences in population distribution and land use in these two areas. As a result of these differences, average traffic volumes on King's Highways in the well-developed regions of Southern Ontario are almost four times the traffic volumes on King's Highways in Northern Ontario. Accordingly, different values for highway classification were adopted for each of those two areas.

The boundary selected runs close to the southern limit of the Precambrian Shield. This is about the northern limit of county organization and of intensive agricultural development in Ontario.



INTERCENTRE SERVICE

An important function of the King's Highway System is to serve traffic between cities and towns. The green bands represent the intercentre service rating of each King's Highway. This was measured by the traffic-generating potential of each major population centre, as determined by extensive traffic surveys. Note that the most important traffic service is performed by Trunkline and Freeway highways.

RESULTS OF CLASSIFICATION

A complete King's Highway System has been selected. Within this system, a wide range in character of service dictated three major classes. These classes, all interdependent, are:

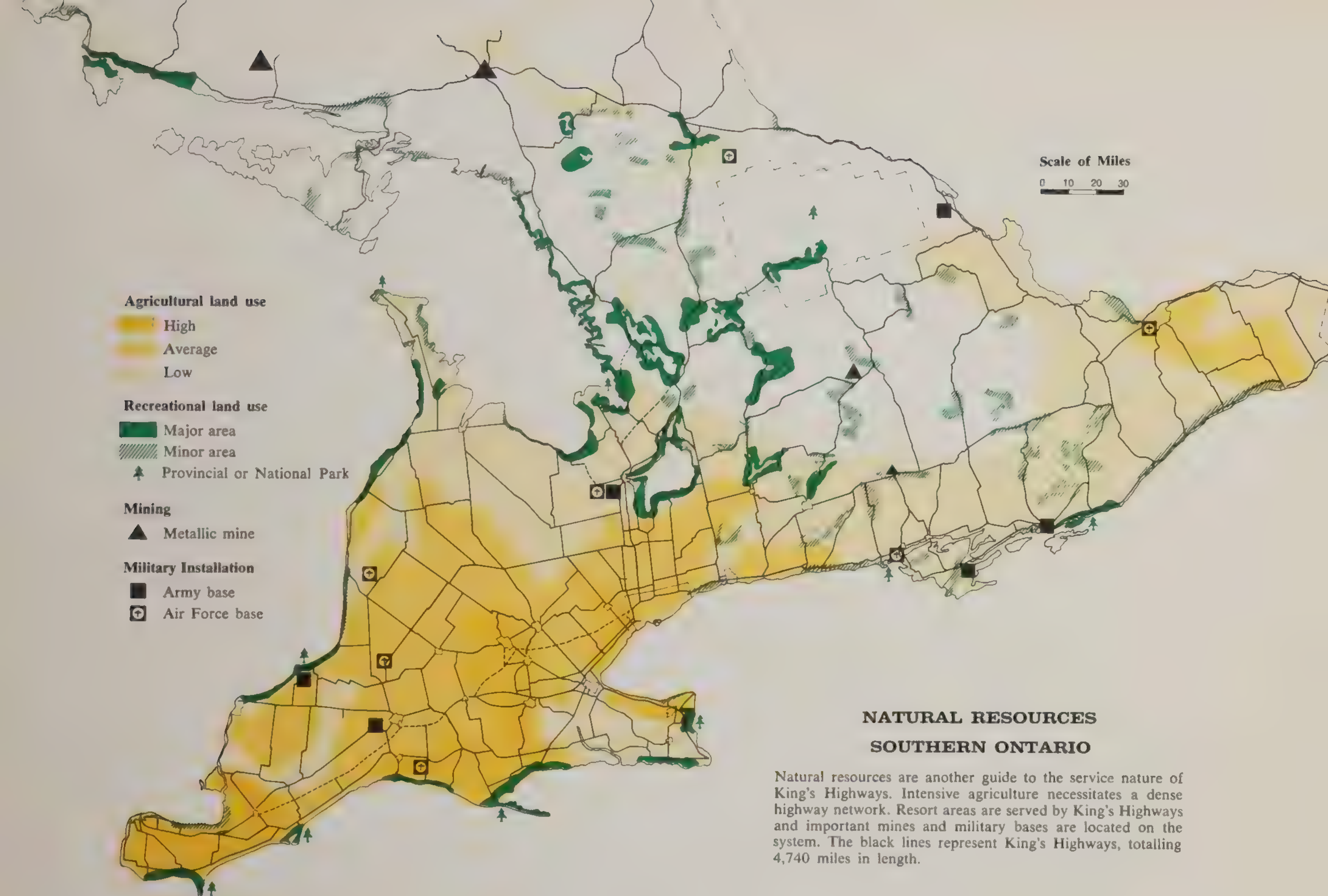
Freeway Highways: Major international and interprovincial routes connecting metropolitan centres and having the highest traffic volumes. Such routes ultimately will require access control plus the highest design standards; hence the name "Freeway".

Trunkline Highways: Routes having relatively large traffic volumes and completing a network of highways that connect all other large cities and important areas of the Province.

Feeder Highways: Routes that are not essential to the interconnection of the system but that maintain a desirable and consistent level of service to all areas.

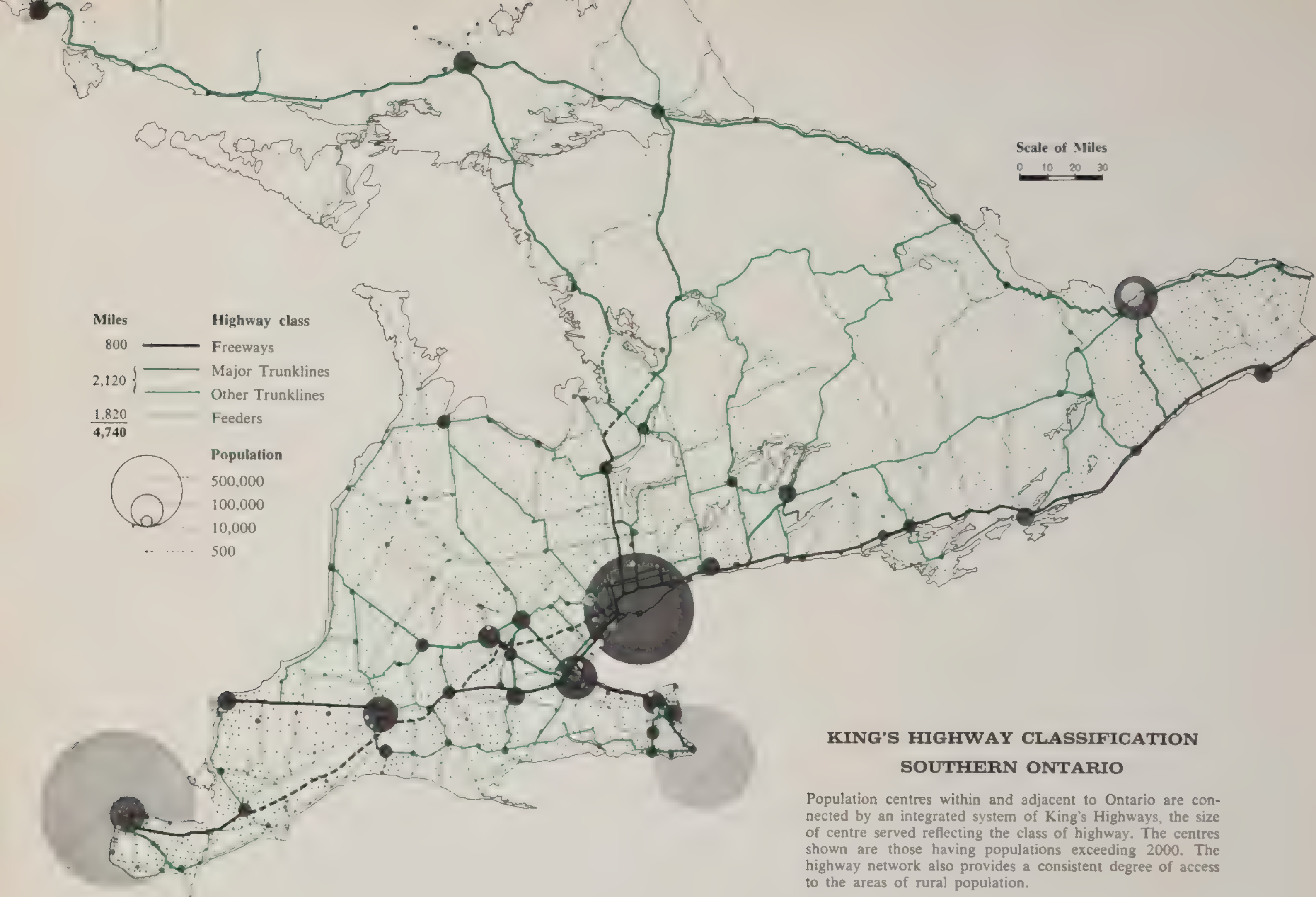
SOUTHERN ONTARIO

As stated earlier, Southern and Northern Ontario were studied separately because of the major differences in economic and geographic characteristics. The results of these two studies were combined to provide a complete province-wide network of King's Highways. The following section deals only with Southern Ontario, the selected classes being shown in the map on page 27.



NATURAL RESOURCES
SOUTHERN ONTARIO

Natural resources are another guide to the service nature of King's Highways. Intensive agriculture necessitates a dense highway network. Resort areas are served by King's Highways and important mines and military bases are located on the system. The black lines represent King's Highways, totalling 4,740 miles in length.



KING'S HIGHWAY CLASSIFICATION
SOUTHERN ONTARIO

Population centres within and adjacent to Ontario are connected by an integrated system of King's Highways, the size of centre served reflecting the class of highway. The centres shown are those having populations exceeding 2000. The highway network also provides a consistent degree of access to the areas of rural population.

The highways of Ontario differ greatly in physical characteristics and type of traffic. Ontario's newest highway, No. 401, shown where it passes through Metropolitan Toronto (top) is built to freeway standards. Highway No. 5 near Cooksville (centre) is overburdened with heavy traffic. The new road to uranium fields near Elliott Lake (left) will see accelerated use, and will need to be rebuilt to higher standards.

FREEWAY HIGHWAYS

The Freeway Highway class consists of routes carrying large amounts of through traffic of interprovincial and international importance. This class connects the four metropolitan centres of Toronto, Montreal, Detroit and Buffalo. In addition it serves other high-density population areas. Sixty percent of Ontario's population is within five miles of a Freeway Highway.

The Freeway class also connects the largest summer tourist area in Canada, the Muskoka-Georgian Bay region, with the large centres of Southern Ontario, Michigan, and New York.

Freeway routes total 800 miles, about one percent of the total mileage of Ontario's highways, roads and streets, and serve almost 15 percent of total rural and urban travel. These routes are the backbone of Ontario's highways.

TRUNKLINE HIGHWAYS

The Trunkline Highway class, integrated with the Freeways, produces a complete network of highways interconnecting all important regions and urban centres throughout the Province.

A detailed analysis of Trunkline Highways indicated that a further subdivision into two subclasses was necessary.

Certain Trunkline Highways have much higher service characteristics than the remaining routes. The superior routes did not in themselves make up an integrated highway network. However, their functional importance warranted superior engineering standards. Therefore they were segregated from remaining Trunklines in the classification plan, and named "Major" Trunkline Highways.

Major Trunkline Highways connect large population centres not otherwise served by Freeways, and they carry heavy traffic volumes and intercentre trips. All cities in Southern Ontario with a population of 20,000, or greater, are located on a Major Trunkline or a Freeway.

Trunkline and Freeway routes serve all important traffic volumes and intercentre desires. All counties and all towns with a population of 4,000, or greater, are served by a Trunkline or Freeway. These two highway classes include 62 percent of King's Highway mileage in Southern Ontario and serve 82 percent of all traffic on the King's Highway System.

FEEDER HIGHWAYS

The selected Feeder Highway class consists of the remaining highways essential to a proper total King's Highway System.

In selecting Feeder routes it was recognized that a King's Highway System, as well as serving traffic generated in cities and towns, should also collect and distribute long-distance traffic generated in rural areas. Accordingly, the classification adhered to the principle that the *inhabitants of any rural area should have a King's Highway as nearby as have the inhabitants of other rural areas with similar development.*

For this purpose, the distances between King's Highways for different densities of rural population were determined. Particular areas, where the distance between King's Highways differed widely from the average in similarly populated areas, were studied further for possible system adjustments. Thus new highways were recommended for areas considerably under-serviced. In areas the study found to be over-serviced, the removal of highways from the system was recommended.

The selected Feeder class provides a consistent and desirable level of accessibility to King's Highways in rural areas and at the same time provides connections between small communities. All communities with a population of 2,000 or greater are served by at least a Feeder Highway, and many smaller places are on the routes as well.

CLASS CHARACTERISTICS

All considerations of predominant importance to a province-wide highway system are met by the selected King's Highway System.

The table below records the existing service characteristics of the several selected classes of King's Highways in Southern Ontario.

Future over-all increases of the indicated values on the various systems will not make necessary major changes in the classification, since all values are relative, not absolute. The data illustrate the different functions of each class and demonstrate the need for different administrative and engineering treatment.

In addition to the aforementioned service characteristics, the King's Highway System serves the natural resources of Ontario and those features of land use that are of province-wide importance, as shown in the map on page 26. All important tourist areas are accessible to the system. Major military installations are served. Mining and forestry developments are included and areas of farm production are connected with their urban markets.

KING'S HIGHWAY CLASSIFICATION-NORTHERN ONTARIO

The widely scattered communities of Northern Ontario are connected by a system of lengthy arterial routes. As new areas are developed the traffic generated must be provided for by highways of appropriate class. Existing traffic flows do not warrant Freeway class highways in the north.

NORTHERN ONTARIO

The King's Highway network in Northern Ontario was developed to provide necessary connections between far-flung centres of population in Ontario, with little regard for the magnitude of traffic then using the highways. As the great resources of the north were developed, highways supplied access to them and their resulting population centres. At the same time, new development was stimulated along the highways.

Accordingly, the chief factors considered in a classification of Northern King's Highways were the importance of development areas, as well as intercentre service and traffic volume.

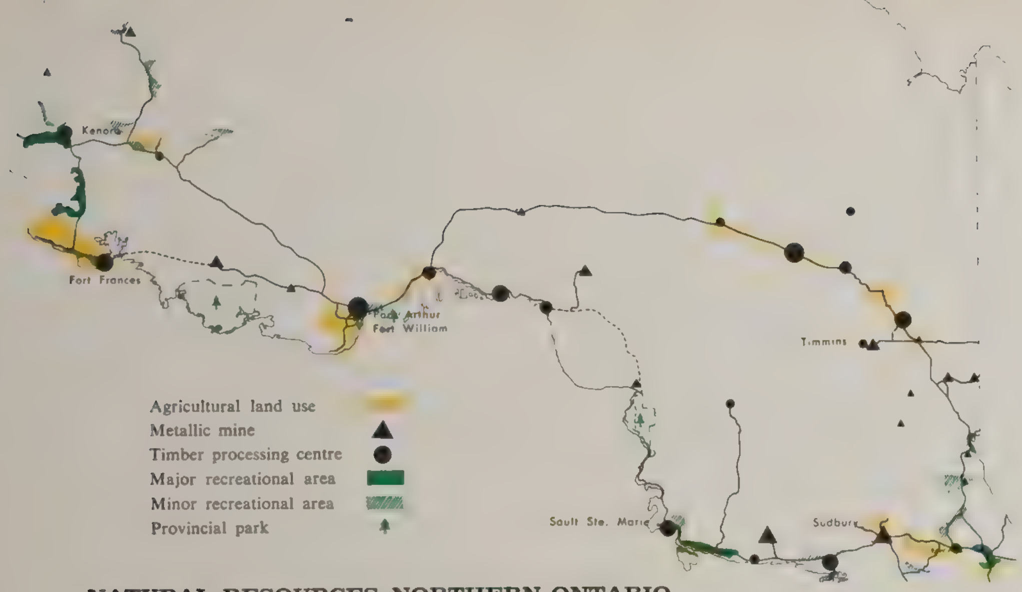
It was apparent that no routes qualified for Freeway status — thus only two classes were adopted: Trunklines, subdivided into Major and Other Trunklines, and Feeder Highways. These classes were the counterparts of those in the south,

CLASS CHARACTERISTICS
SOUTHERN ONTARIO

Class	INTERCENTRE SERVICE *(Point Rating)*	AVERAGE TRAFFIC *(Vehicles per day)*	THROUGH TRAFFIC *(Vehicles per day)*
Freeway	35	6,100	3,400
Trunkline	4	2,500	550
Major	(8)	(3,800)	(1,300)
Other	(3)	(2,000)	(300)
Feeder	—	1,200	—
	(Average)	2,600	

SUMMARY OF CLASSIFICATION
SOUTHERN ONTARIO

Class	MILES *Number*	*Percent*	TRAVEL *Percent*
Freeway	800	17	39
Trunkline	2,120	45	43
Feeder	1,820	38	18
Total	*4,740*	*100*	*100*



NATURAL RESOURCES–NORTHERN ONTARIO

Natural resources, and the communities associated with them are paramount in the evaluation of King's Highway service in Northern Ontario. Agriculture is not significant in these areas, whereas mining, forestry, and recreational developments are of major importance.

taking into account the different type of service required in the two areas. The selected System and classes are shown in the map on page 29.

MAJOR TRUNKLINE HIGHWAYS

It was recognized that a Major Trunkline Highway was required as an interprovincial route across Northern Ontario. The route selected passes through Sault Ste. Marie and closely parallels the north shore of Lake Superior to the Lakehead. That highway will provide service between the five major cities of Northern Ontario—Fort William, Port Arthur, Sault Ste. Marie, Sudbury, and North Bay; it will provide access to important mining developments; it will provide a shorter route to the west through Ontario from eastern Canada; and it will link up major U.S. highways. From Sudbury westward, it is the route of the Trans-Canada Highway.

The Major Trunkline class connects interprovincial and international routes, serves major population centres, and provides access to important mining, forest and tourist areas.

TRUNKLINE HIGHWAYS

Other important cities and towns in Northern Ontario, as well as major centres of mining, pulp and paper production, and tourist attraction are served by Trunkline Highways. All places with a population of 2,000, or greater, are on a Trunkline Highway.

The great future growth expected of new mining developments at Elliot Lake, Manitouwadge, and Atikokan was considered. Trunkline Highways, some to be constructed at a future date, were recommended for service to those centres.

FEEDER HIGHWAYS

Those remaining highways that served smaller communities, moderate traffic volumes and minor developments were designated as Feeder Highways. All places of over 500 people are located on at least a Feeder route, and many smaller places are also served. Each area was provided access consistent with its population density, as determined in a manner similar to that for Southern Ontario.

CLASS CHARACTERISTICS

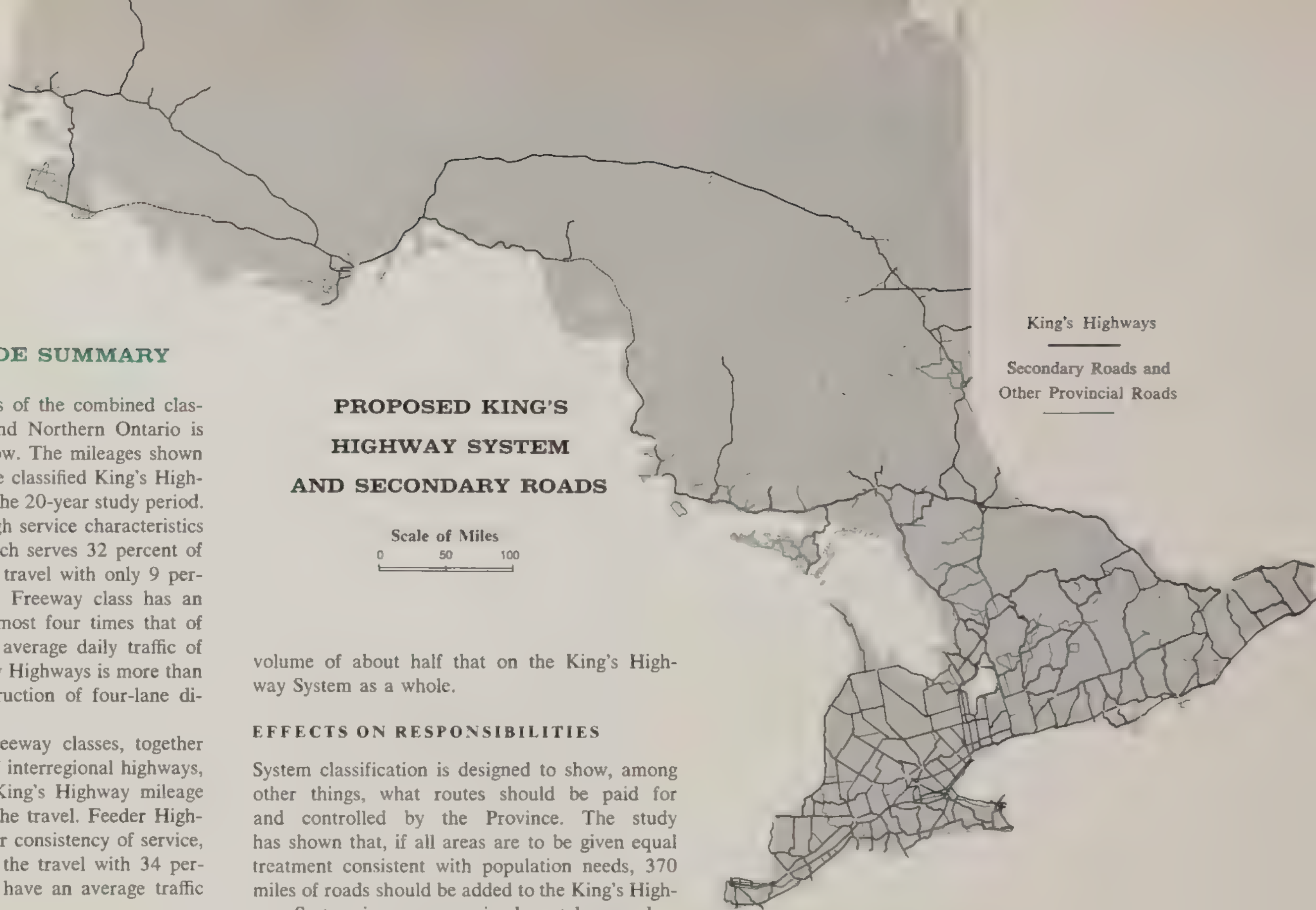
The tables below show the distinction between classes of King's Highways in Northern Ontario. Comparison of these tables with those on page 29 will quickly show the difference between Northern and Southern Ontario.

CLASS CHARACTERISTICS
NORTHERN ONTARIO

Class	INTERCENTRE SERVICE *(Point Rating)*	AVERAGE TRAFFIC *(Vehicles per day)*
Trunkline	3.2	700
Major	(4.5)	(800)
Other	(1.7)	(600)
Feeder	—	450
		(Average) *600*

SUMMARY OF CLASSIFICATION
NORTHERN ONTARIO

Class	MILES *Number*	MILES *Percent*	TRAVEL *Percent*
Trunkline	2,800	73	80
Feeder	1,060	27	20
Total	*3,860*	*100*	*100*



PROVINCE WIDE SUMMARY

A summary of the results of the combined classifications of Southern and Northern Ontario is recorded in the table below. The mileages shown represent the extent of the classified King's Highway System at the end of the 20-year study period. The data illustrate the high service characteristics of the Freeway class, which serves 32 percent of the total King's Highway travel with only 9 percent of the mileage. The Freeway class has an average traffic volume almost four times that of the whole network. This average daily traffic of 6,100 in 1955 on Freeway Highways is more than enough to warrant construction of four-lane divided highways.

The Trunkline and Freeway classes, together making up the network of interregional highways, have 66 percent of the King's Highway mileage and serve 82 percent of the travel. Feeder Highways, though necessary for consistency of service, serve only 18 percent of the travel with 34 percent of the mileage, and have an average traffic volume of about half that on the King's Highway System as a whole.

SUMMARY OF CLASSIFICATION - ALL ONTARIO

	MILES		TRAFFIC	TRAVEL
Class	*Number*	*Percent*	*Veh. per day*	*Percent*
Freeway	800	9	6,100	32
Trunkline	4,920	57	1,500	50
Feeder	2,880	34	900	18
Total	*8,600*	*100*	*(Avg.) 1,730*	*100*

EFFECTS ON RESPONSIBILITIES

System classification is designed to show, among other things, what routes should be paid for and controlled by the Province. The study has shown that, if all areas are to be given equal treatment consistent with population needs, 370 miles of roads should be added to the King's Highway System in areas now inadequately served.

In addition to the King's Highway System, the Province is also fully responsible for a group of Secondary Roads totalling 2,400 miles in length. The classification study did not evaluate these roads as to the degree of provincial interest in them and merely assumed that they would remain the responsibility of the Province, as they now are.

A number of roads totalling 570 miles in length, that are now included in the King's Highway network, do not have the characteristics of King's Highways as described in the study. The administrative control of such highways is not the subject of the present report, but it should be recognized that roads that do not qualify as King's Highways should be placed in categories consistent with the service they perform, to ensure the

appropriate standards of improvement and maintenance and for operational and administrative efficiency. For the same reasons the assumption into the King's Highway System of other unsuitable roads should be discouraged.

It is expected that, as some new sections of King's Highways are built to replace existing nearby routes, some of the latter may acquire characteristics of other than King's Highway status.

CONCLUSION

The attempt has been made to construct a classification plan that provides a consistent and sound King's Highway System, based upon a thorough application of current techniques and principles of classification. It will not solve all problems of highway administration, but should provide a valid framework for their consideration.

Changed conditions may result in necessary revisions at relatively long intervals. Some important adjustments may result from subsequent studies of needs in certain cities and towns in Ontario. However, these should be changes in detail only and should not affect the broad plan.

In any event, the objective is to obtain systems that are functionally consistent throughout the Province and its subdivisions, and that are firmly fixed so that estimates, programs, finances and organization are stabilized on a consistent basis for a long time. Otherwise, planning and legislation are in a constantly shifting condition, making orderly development impossible.

It is hoped that as a result of the selection of a King's Highway System providing a basic plan for highway development, the benefits of functional classification as stated on page 24 can now be attained. When other roads and streets in the Province are reviewed for their proper classification, better results may be achieved by all agencies of government working in cooperation.

Highway construction requires skilled workers and heavy machinery. Shown above is grading along Highway 41 in the Bancroft district.

THE APPRAISAL

CHAPTER FOUR

The foregoing chapters presented the challenging current need for highways; outlined the present legal and financial status of provincial highway responsibilities; and evaluated and classified highway service to traffic. This chapter describes the engineering appraisal of the existing highway plant and records present highway deficiencies. It also explains the procedures used to determine the improvements needed to serve adequately Ontario's increasing traffic.

For the first time, Ontario's main traffic arteries have been completely surveyed and a highway improvement plan has been established for anticipated conditions. Further, the total costs, including maintenance and replacement, have been determined.

This most comprehensive stage of the needs study, which is based on proven engineering principles, establishes a plan adequate for all foreseeable demands, and guarantees the best use of the large public investment in highways. All the King's Highways and Secondary Roads were studied with the participation of all branches of the Department of Highways.

METHOD USED

Four important steps were taken to achieve the above objectives:

First it was necessary to set standards for modern highway designs adequate for 1976 traffic, since roads built now should last at least 20 years. For each road economically feasible standards were selected for its traffic, terrain, and class.

Secondly, every effort was made to fit all existing roads and bridges into the study of needed development. This involved a careful inventory of all present facilities, plus the estimating of the costs of reconstructing certain facilities or of developing new ones where necessary.

Thirdly, because all work cannot, or need not, be done at once, a method of timing the construction of projects was established. Most older highways are inadequate in some degree ranging from minor to critical, when measured against modern standards. Some defects must be endured while more severe ones are being corrected. Therefore, levels of acceptability of existing facilities, known as "Tolerable Conditions", were set to measure the degree of urgency for improvement.

Fourthly, all cost estimates for improvement, replacement, maintenance and operation of the highway plant were converted into feasible annual work programs. Alternative programs were prepared for different fiscal possibilities.

STANDARDS

Design Standards define the kind of highway needed to meet particular traffic conditions. They were the basis for the highway improvement program, for they dictated what must be done to produce an adequate system.

Tolerable Conditions represent a relaxation of Design Standards, and define a limit of service below which the public interest is not served. They were used to locate highway sections that are intolerably deficient now, and that should be improved or replaced at once. The study of traffic growth and of pavement life showed also when the remaining facilities would become intolerable.

DESIGN STANDARDS

Given the conditions of future traffic demand as measured in the highway classification, and of local terrain, it was essential to specify the kind of roadway or bridge that would provide adequate service throughout the life of the pavement at a reasonable cost. The general specifications governing bridge and highway design for King's Highways and Secondary Roads have been recorded in the Appendix (pages 55 and 56).

These design standards, which provide for the different conditions likely to be met in practice, were developed by engineers of the Department of Highways. They were based on recommendations of recognized highway research organizations with appropriate modifications to allow for conditions found in Ontario. They are an improvement upon previously accepted standards and demonstrate recognition of the need for greater safety and better service to traffic.

HIGHWAY DESIGN FACTORS

Traffic	Volume Variations Character Change
Vehicles	Size Weight Power
Drivers	Reaction Speed Convenience Safety
Cost	Operation Rights-of-way Construction Maintenance
Location	Rural Urban Suburban Terrain
Service	Through Local Combined
Conditions	Soil Climate Water
Construction	Materials Methods

Freeway standards, illustrated here on the Queen Elizabeth Way, call for multi-lane divided pavements, interchanges with grade separation, and service roads where necessary.

ROADWAY STANDARDS

Freeway highways carry large volumes of long-distance, high-speed traffic, including many commercial vehicles. Accordingly, these highways require multi-lane divided roadways, with the highest standards of design and operating speeds; which in turn bring about easy grades and curves, and safe stopping distances. Further, the widest roadways and the heaviest pavements must be prescribed to serve safely and efficiently the large and heavy commercial vehicles travelling on Freeway highways. Finally, to protect the public investment in highways and to keep them adequate for increasing volumes of traffic, control of access and separated intersections are called for on all Freeway locations.

These features, experience shows, cut highway deaths by two thirds. In addition, such standards, which provide freedom from stop lights and cross traffic, permit average speeds of from 50 to 55 mph in periods of near-peak traffic.

Major Trunkline highways, having high traffic volumes, require standards similar to those of Freeways, particularly for new locations and where economically feasible.

The remaining Trunkline highways and the Feeder highways have design standards suitable to their role as carriers of lower-speed, shorter-

trip traffic. Nevertheless, the King's Highway System throughout was assigned the highest standards of rural traffic service in the Province.

STRUCTURE STANDARDS

Bridge standards are tabled on page 55. They prescribe that bridge roadway widths vary in accordance with class of highway, traffic volume and length of span. Also a uniformly high standard of load limit and vertical clearance height is set for all bridges to serve the large and heavy vehicles that travel over all parts of the King's Highway System.

These standards will assure the construction of bridges having comfortable and safe clearances and not requiring undue load limits.

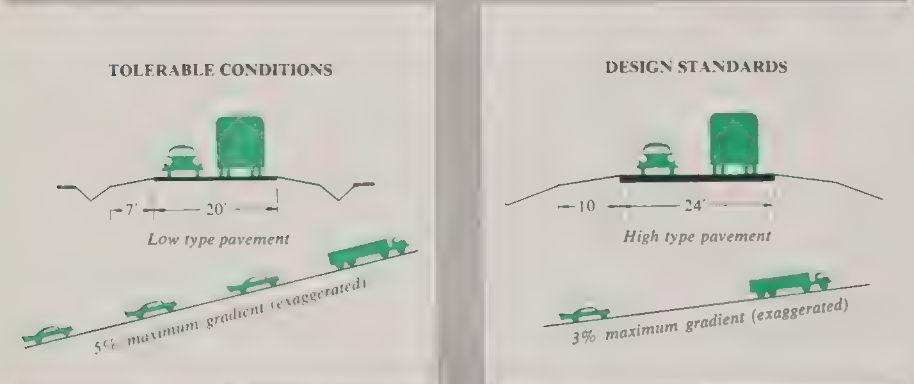
SECONDARY ROAD STANDARDS

Design standards for roadways and structures are lower for Secondary Roads than for King's Highways, in accordance with the lower traffic volumes which Secondary Roads normally carry, and with the lower service characteristics resulting from their status as local-access, outlying roads. Accordingly lower design speeds and lighter pavements have been recommended for these roads.

RAILROAD CROSSING STANDARDS

Railroad crossing standards have been adopted to guide King's Highway reconstruction at railroad crossings. They provide for grade-separation structures on all multi-lane highways and on all other highways where train traffic causes serious delays; signals and gates, at least, are called for on all major trunkline highways and on other heavily travelled highways having double-track crossings; all other locations would have flashing signals. These minimum standards of protection are recommended for all King's Highways, and at the crossings where accidents and delay are major problems additional protection would be provided.

TOLERABLE CONDITIONS CONTRASTED WITH DESIGN STANDARDS



Tolerable Conditions represent minimum acceptable values for highway features and determine the need for improvement. The *Tolerable Condition* values are well below Design Standards. Shown here are a few of the elements studied, the values being for two-lane, Major-Trunkline highways.

TOLERABLE CONDITIONS

The criteria by which highways and bridges were judged intolerably deficient are recorded on page 56 of the Appendix, and are tabulated in a form similar to that used for the design standards, although the values used are lower. The tolerable conditions represent minimum values of different highway elements and in most cases, as outlined below, determine when reconstruction is required.

The values were based upon highway safety and the economics of traffic operation and highway construction. For example, where the condition of a pavement is so bad that maintenance is uneconomical, then some form of reconstruction to modern standards is justified. Similarly, where traffic frequently has to travel at speeds considerably less than design values, major improvements are warranted to remove congestion. Intolerable pavement widths, surface types, curves and grades, as well as accident proneness, also justify highway improvements. Similar criteria were established for bridges, railroad crossings, and urban highway sections.

PROCEDURES

The engineering study of highway needs involved several important steps, which were taken in the following sequence:—

1. Inventory of existing conditions
2. Evaluation of traffic data
3. Selection and application of standards

Deficient pavement condition afflicts 28 percent of King's Highway mileage, as illustrated on Highway No. 69 near Gravenhurst.

4. Determination of deficiencies
5. Appraisal of type and cost of improvement
6. Review and tabulation of study data
7. Estimation of maintenance and other costs
8. Program development.

The procedures followed during each step were suggested by the practice and experience of other highway organizations and were established after consultation with engineers of the Planning and Design Branch and of the Operations Branch of the Department of Highways.

The scope of the study included roadways and structures on all King's Highways (excepting those in urban centres of greater than 5,000 population) and on all Secondary Roads.

INVENTORY OF EXISTING CONDITIONS

The questions to be resolved in the study called for the detailed assembly of all pertinent facts and professional judgments.

Therefore, an exhaustive inventory of the existing highway system was made. Some of the data required were available in the records of various Departmental offices. The gaps were filled in from special surveys by head office and from special reports prepared by the eighteen district offices of the Department of Highways.

For each part of the highway system it was necessary to learn

a) the type, physical condition, and anticipated life of the vital structural parts of the highway, that is, the roadways themselves, and the bridges.
b) the important physical dimensions, that is, roadway widths, clearances, the steepness of grades and sharpness of curves, and the existing sight distances.
c) the kind of terrain (economics dictate that standards be reduced in rugged terrain).

An example of geometric deficiency is this narrow bridge and its sharply curved approaches on Highway No. 49.

After this and other necessary information had been gathered, the next step was to divide the highway system into study sections having approximate uniformity. These were composed of 1,900 rural roadway sections, (with an average length of 4.6 miles) and 1,750 bridges and railroad crossings. In addition, sections on King's Highways within 158 urban centres of 1,000 to 5,000 population were isolated for special study.

EVALUATION OF TRAFFIC DATA

Complete and accurate information about the movement and type of vehicular traffic on the King's Highways and Secondary Roads was assembled by the Traffic Section of the Department of Highways.

The daily and hourly volumes of traffic on each study section were related to the service characteristics of the highway, as indicated by the widths of

Because of too few lanes and poor alignment, 700 miles of rural King's Highway have insufficient traffic capacity, as shown on Highway No. 11.

Inadequate facilities on urban sections of King's Highway cause congestion and delay, as shown on Highway No. 2 in Trenton.

roadway, by the available passing opportunity and by the degree of roadside interference. In this way, a measure known as "practical capacity" was obtained of the ease of traffic movement along each highway section; the resulting information formed part of the analysis of its deficiencies.

Increases in these traffic volumes were projected over the next twenty years as a guide to probable future needs.

In addition, the accident experience of each study section, another important indication of highway adequacy, was obtained from the records of the Traffic Section.

SELECTION AND APPLICATION OF STANDARDS

It was necessary to select the appropriate design standards and tolerable conditions for each study section. Selection was governed by the highway

class, the traffic volume anticipated in twenty years' time, (that is, within the life of the pavement) and the type of terrain in which the section was located. These factors were applied to the tables on pages 55 and 56 of the Appendix and the controlling elements for design and tolerability were determined.

DETERMINATION OF DEFICIENCIES

The next step was to discover the existing and future deficiencies of the roadways and bridges. These were located by comparing the inventory and traffic data for each location with the corresponding tolerable condition values, according to the principles described earlier.

For those locations that were not now intolerable, the nature and time of future deficiencies were estimated. For this purpose the anticipated increase in traffic volume and the life expectancy of the existing pavement or bridge structure were utilized for each location. In this way the sections needing work now or at designated future periods were located.

Since most existing highway pavements normally have a useful life of less than twenty years, it was anticipated that work would be required on nearly all highway sections during the twenty-year study period. However, since bridge structures have life expectancies of up to fifty years, replacement of all bridges was not anticipated.

Existing deficiencies on King's Highways as located by this analysis have been recorded at the end of this chapter.

TYPE AND COST OF IMPROVEMENT

The time period for needed improvements and the design standards having been established, the summary forms, containing all analysis data, for each roadway section were despatched to the District offices. Members of the construction staff of each District then prepared an appraisal of what form of construction was required to improve each section to the standard prescribed.

An estimate was made of the construction costs, broken down into their various components, necessary to carry out the required improvement for each section. The estimates were based on actual costs of like work completed in 1955 at similar locations. No attempt was made to foresee future price fluctuations.

MAJOR NEW LOCATIONS

It was foreseen that, when certain highways carrying large traffic volumes became intolerable, it would be impossible to make the necessary improvements on the existing locations. This was particularly true where multi-lane and controlled access standards were required. Solutions to these major problems of location and design were determined by consultation within the Planning Division of the Department of Highways. Thus a highway network was laid out designed as the best present engineering answer to Ontario's twenty-year service requirements.

The estimating for the major new locations was done by the Design Division, and the Services Branch assisted throughout in estimating right-of-way costs. Urban costs were estimated by the Traffic Section and bridge structure costs by the Bridge Design Section and the Railway Liaison Engineer of the Department of Highways.

Thus, an estimate of the costs of future highway improvement was prepared, based upon a detailed analysis by experienced personnel. When this operation was completed the results were returned to the Statistics and Economics Section of the Department of Highways for the final phases of the analysis.

REVIEW AND TABULATION OF STUDY DATA

A general review of all study results was carried out to discover errors and inconsistencies, and to guarantee uniformity of design and costs.

When this review was finished and the forms completed, the assembled information was transferred to business machine punch cards for convenient tabulation. This information includes mileages, deficiencies, needed improvements, and construction costs, some of which are recorded later in this report.

MAINTENANCE AND OTHER COSTS

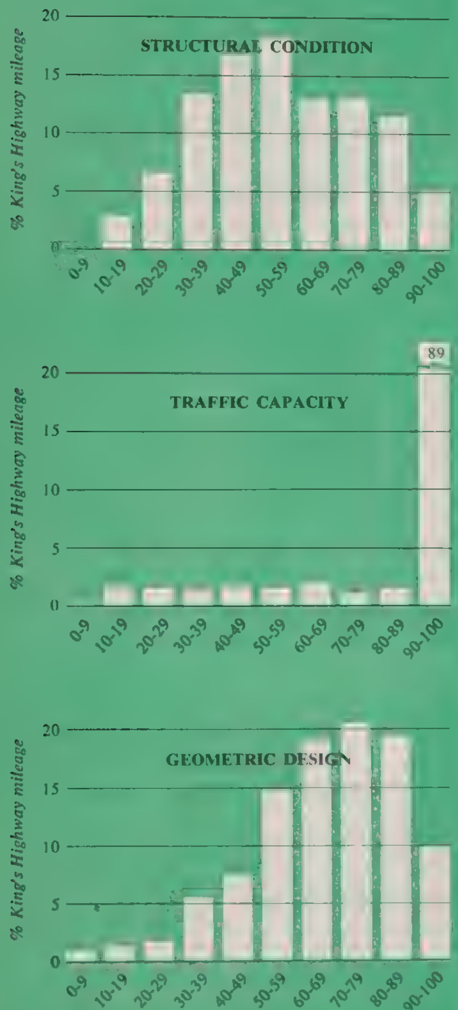
The highway improvements described thus far are all of the construction or permanent type of highway work. However, in the development of a highway network there is required the routine, year-by-year work of maintaining the highway plant in operating condition, and no appraisal of future highway needs would be complete without the inclusion of anticipated maintenance costs.

Based upon a study of records of maintenance expenditure, estimates were made of annual maintenance costs per mile for each type of pavement. These were applied to the future mileage of the different pavement types to obtain future total maintenance costs.

Another necessary expenditure is for a class of temporary highway improvement known as stop-gap work. This is an added requirement resulting from the inability to perform all needed construction at the time of intolerability. It consists of minimum construction work necessary to maintain the highway components in a tolerable service condition until it is feasible to rebuild to design standards. Estimates of stop-gap costs were made, based upon past experience. They range from about four to eleven percent of construction costs, depending on the speed with which existing backlog work can be done.

Another cost which must be added is that for resurfacing and minor reconstruction, which past experience shows will be required in time on all improvements. These costs depend upon the type of original construction and the age of each improvement at the end of the study period. From

KING'S HIGHWAY SUFFICIENCY RATINGS



two to 50 percent of new roads would require such additional work.

In addition, administrative costs were included, as described in the next chapter.

PROGRAM DEVELOPMENT

A major objective of the study was to determine *total* costs of the several highway systems for various future periods. This required extensive tabulation and computation of the various cost data referred to in the previous section. Over 300 tables were prepared for the various combinations of basic information necessary. Summaries of program costs and various alternatives are shown in Chapter V.

SUFFICIENCY RATINGS

Another objective in the analysis of highway needs was to establish acceptable programs of construction for the next few years. This necessitated arranging the most needed highway improvements in order of priority. Before final working priorities were arrived at, many factors were considered. However, one of the first steps in this process was to establish a preliminary listing by using four priority ratings:—

1. **Structural Sufficiency**—an evaluation on roadways of such elements as surface and shoulder condition, subgrade and drainage, maintenance demand, and expected pavement life.

2. **Capacity Sufficiency**—an evaluation of the ability of a highway section to serve without congesting the traffic flowing on it.

3. **Geometric Sufficiency**—an evaluation of the geometric or alignment elements of each highway section, including sharpness of curves, steepness and length of grades, width of pavement and shoulder, opportunity to pass, stopping sight distance and the accident record of each section.

4. **Cost per Vehicle-Mile**—the total cost of the improvement divided by the product of the 1955 average daily traffic volume and the length of the highway section. This value provides a rough measure of the relative economic justification of individual projects.

Each rating, except the last listed, has a top value of 100 points for a facility completely adequate for 1955 traffic needs. A specified number of points, totalling 100, was assigned to each of the important features of the roadway or structure. In a given study section, a feature measuring up completely to the appropriate design standard would be awarded full points. A feature that fell short would be awarded a lesser number of points, according to the set scale of values. In this way, a numerical rating was built up which made it possible to compare rapidly the "sufficiencies" of the various study sections, and priority would be inverse to sufficiency. A general view of the rating status of present King's Highways is shown in the accompanying charts.

STATUS OF SYSTEMS

The analysis of highway needs disclosed the existence of various deficiencies in the Province-controlled highways, roads and streets. A summary of these deficiencies, by system, is as follows:

KING'S HIGHWAY SYSTEM

Of the 8,600 miles of existing King's Highways, 3,800 miles (44 percent) are intolerable by the criteria of the study.

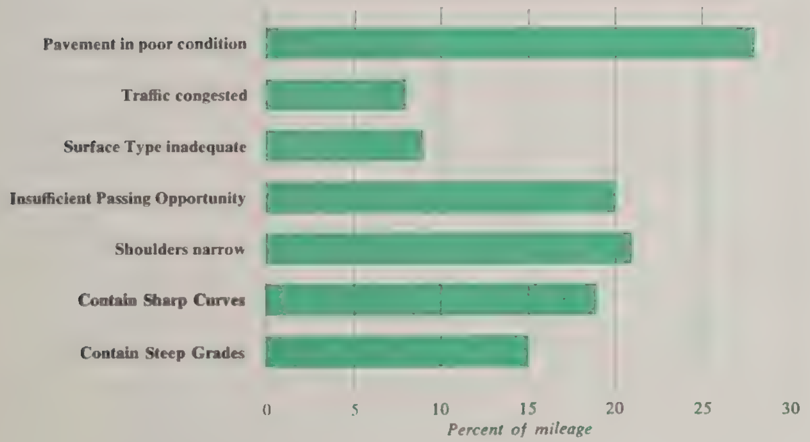
In addition there are many miles containing various deficiencies that are not considered severe enough to warrant immediate improvement. The following summary of deficiencies includes both these intolerable sections and these deficient-but-tolerable sections. Much of the mileage has more than one type of deficiency.

ROADWAYS

Roadway deficiencies are listed below and shown on the accompanying chart.

- 2,390 miles (28 percent) of the present King's Highway system have deficient pavement condition.
- 700 miles (8 percent) have deficient traffic

RURAL KING'S HIGHWAY PROBLEMS



capacity resulting in congested traffic flow.

- 810 miles (9 percent) have types of surface that are not heavy enough for their traffic.
- 1,760 miles (20 percent) have insufficient passing opportunity, causing low traffic operating speeds and dangerous driving conditions.
- 1,770 miles (21 percent) have deficient shoulder width, limiting the possibility of emergency manoeuvering and causing parked vehicles to encroach upon pavement.
- 1,630 miles (19 percent) contain sharp curves hazardous even at tolerable speeds.
- 1,320 miles (15 percent) contain steep grades causing traffic slowdowns.

BRIDGE STRUCTURES

- Of the 1,284 bridges and grade-separations on the present King's Highway System, 380 (30 percent) are deficient in width or in load-carrying ability and call for immediate reconstruction or replacement.

RAILWAY CROSSINGS

- Of the 451 level crossings, 59 (13 percent) are deficient because of hazard or of traffic delay and call for immediate improved protection ranging from signals to grade separation.

URBAN KING'S HIGHWAY SECTIONS

- Of the 285 miles of King's Highways in urban centres of 1,000 to 5,000 population, 78 miles (27 percent) of roadway are deficient because of congestion, pavement condition or alignment, and call for immediate improvement.
- Of the 107 bridges in these urban sections, 44 (41 percent) are deficient in width or in load-carrying ability, and call for immediate reconstruction or replacement.

SECONDARY ROADS

- Of the 2,400 miles of existing Secondary Roads, 1,520 miles (63 percent) have intolerable surface condition or surface width, calling for immediate improvement.
- Of the 397 bridges, 98 percent are considered deficient and need reconstruction or replacement.

CONCLUSION

As a result of the engineering appraisal a picture is provided of the existing problems to be solved in developing the Province-controlled routes to standards of adequate service. The succeeding and final chapter outlines the costs of undertaking such a task for present and future deficiencies, and establishes the basis for the preparation of future improvement programs.

CHAPTER FIVE

PROGRAM COSTS

FOR THE FIRST time, there is now available a comprehensive survey of present and future costs for proper development and maintenance of a well selected rural *King's Highway System* in Ontario. Also available are estimates of the costs for *Secondary Roads* and other roads under provincial jurisdiction. Along with these there are data for sections of King's Highways passing through towns and villages of 1,000 to 5,000 population, designated *King's Highway urban sections.*

Thus the total highway needs are estimated, at 1955 prices, over a period of 20 years from April 1, 1956. These results provide the basis for—

- Budget considerations
- Planning of ultimate route improvements
- Annual scheduling of projects.

Not included are certain other departmental costs, chief of which are subsidies for municipalities.

Should roads other than those recommended in the classification study (see Chapter III) be added to the King's Highway System, obviously the costs would be increased. Additions or reversions of Secondary Roads would likewise affect the estimates. Possibly of even greater importance, are the extent of direct control by the Department over connecting links in cities and the amounts of subsidies to be paid municipalities. These are policy matters not covered in this study. The best basis for such decisions would, however, be found in studies similar to those reported here.

Chapter IV has outlined the principles and methods of the highway needs analysis and has disclosed the extent of the existing physical deficiencies in the classified King's Highway System and other roads under provincial jurisdiction. *Chapter V deals with the long-range costs and ultimate development required on Province-controlled routes (including rural King's Highways, sections in centres with 1,000 to 5,000 population and Secondary Roads) to meet the growing traffic needs.*

HIGHLIGHTS

- Capital needs through 1976 total $1.9 billion, and include construction, modernization, replacement and necessary stop-gap action on roads and bridges on Province-controlled routes.
- Of this amount, $782 million is the cost of improvements needed to remedy the backlog of road and bridge defects on 5,400 miles that are intolerable for today's traffic.
- Total needs on these routes for the next 10 years, including proper maintenance and administration, average $183 million annually, at 1955 price levels; municipal subsidies are not included.
- Of total costs, including maintenance, 16 percent is for Secondary Roads and other roads included in this category.
- Some 1,820 miles of multi-lane highways should be built within 20 years, and 620 miles of them are needed now. About 60 percent of King's Highway construction costs would be required for such facilities.
- Some 2,048 bridges should be reconstructed or newly built, and 1,297 of them are needed now.
- Total costs for the King's Highway System average 0.88 cents per vehicle mile of travel over the future 20-year period, as compared to 1.33 cents over the past 18 years.

RURAL KING'S HIGHWAYS

CUMULATIVE COSTS OF INITIAL CONSTRUCTION

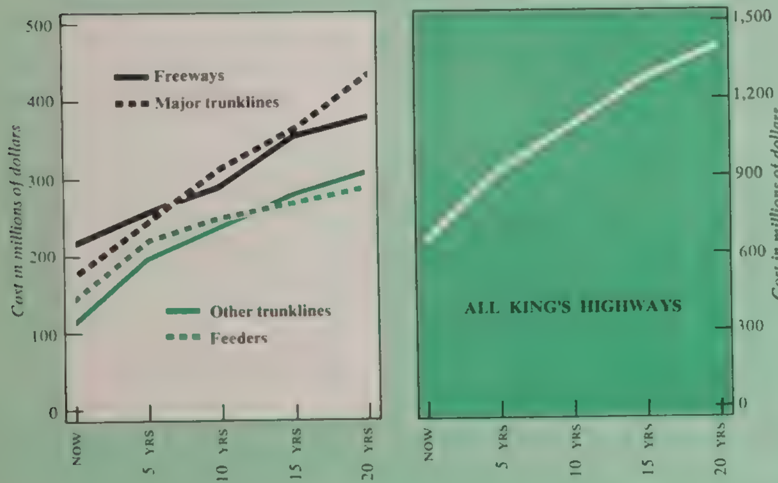


Table One

RURAL KING'S HIGHWAY SYSTEM

Cumulative Costs of Initial Construction *

(in thousands of dollars at 1955 prices)

		TOTAL EXPENDITURES NEEDED			
		Within			
Highway Class	*Now*	*5 years*	*10 years*	*15 years*	*20 years*
Freeway	219,201	258,160	291,638	357,037	383,747
Major Trunkline	176,303	243,590	314,774	368,641	431,799
Other Trunkline	111,237	195,250	234,580	279,808	305,401
Feeder	140,016	217,183	248,043	269,921	287,757
Total	**646,757**	**914,183**	**1,089,035**	**1,275,407**	**1,408,704**

* By "Initial Construction" of highways and bridges is meant permanent work that measures up to the prescribed design standards and is expected to last through a normal life span. This is distinguished from "Replacement", which refers to remedial construction required during the anticipated life span and "Stop Gap" construction which is temporary and of a relatively low standard.

THE KING'S HIGHWAY SYSTEM

During the next 20 years $2.3 billion (at 1955 prices) should be spent for proper development and maintenance of the rural King's Highway System. This is an *average* of $112.5 million annually, as compared with expenditures of $114 million in the year ending March 31, 1956, and an average of $65 million per year over the last decade.

However, the critical deficiencies that exist now, as outlined in the preceding chapter, will cost $647 million to correct—an indication of the effort needed to catch up. The accompanying chart shows initial construction needs, and how much should have been spent to meet them by the end of each coming year. It shows, for example, that it would take over 10 years to catch up to the then current needs if $100 million annually were devoted to initial improvement alone on all King's Highways. Maintenance and other costs, described hereinafter, must be added to this annual sum.

Total initial construction requirements for each of the four classes of King's Highways are charted above and shown in Table One. Present needs of each class and the rate of capital expenditure called for, indicate how the funds allocated for improvements should be distributed. Comparison of future expenditures with the accumulating needs will show the rates of progress required.

COST ELEMENTS

The principal costs in a complete highway program are those involved in making the necessary initial improvements, but these are not the only costs required.

Highways, like all other things, wear out; funds must be included for the resurfacing and replacement of some mileage. The amount and location of such work can be reasonably predicted for existing highways and bridges that can be examined, and whose history is known. This has been done and the cost estimates are included in the table and charts referred to above. On the basis of such analysis, it has also been predicted that some additional funds will be required for resurfacing and reconstruction of roads and bridges initially constructed during a given period. Amounts are relatively small, and depend on how much new work is put in place each year.

Also, since such a large backlog of work exists that it is manifestly impossible, for a number of years, to become and remain up to date, some

BACKLOG NEEDS ON KING'S HIGHWAYS
SOUTHERN ONTARIO

Construction projects needed now to take care of existing highway and bridge deficiencies on the King's Highway System are shown in green, with arrows for isolated bridges. Most of the remaining mileage on the system shown by white lines will require improvement some time within the 20-year study period.

money will have to be spent for stop-gap measures on existing roads. Resurfacing or temporary improvements will have to be made to serve traffic, pending the time when fully adequate facilities can be built as planned in this study. If these are long delayed, stop-gap costs will be higher than if the backlog is caught up rapidly. The sums in this study included for stop-gap action range from 4 to 11 percent of the initial cost, depending on the period length of the catch-up program.

MAINTENANCE AND ADMINISTRATION

A complete statement of highway costs would be incomplete without provision for maintenance and administration. Analysis of past maintenance costs as a basis for estimating future requirements was described briefly in Chapter IV.

Here it was shown that an average of about $19.1 million per year was spent for direct maintenance of rural King's Highways and bridges during three years between 1951 and 1955. (One year when data were not complete was omitted.) The figure excludes overhead and betterments, such as heavy resurfacing, performed by maintenance forces. In this report, such work is included in the capital costs of the construction program. Net maintenance costs increased from $18.3 million in 1952 to $20.4 million in 1955, and represented about 26 percent of all expenditures on King's Highways in those three years.

Average annual costs per mile were $2,370 for two-lane roads and $7,010 for four-lane divided highways. Records show that the maintenance dollar was spent more or less as follows:

For surface repairs	45 percent
For roadsides and drainage	15 percent
For snow and ice control	38 percent
For safety and traffic control devices	2 percent
	Total 100 percent

Future costs for maintenance will depend on the extent and character of the road system, on the need for increased emphasis on the various items of work and on the efficiency of maintenance forces. It is estimated that a total of 12 percent more funds should be spent on existing highways, and that the amounts for roadsides and drainage, and for safety and traffic control devices, should be increased by about 20 percent above present levels.

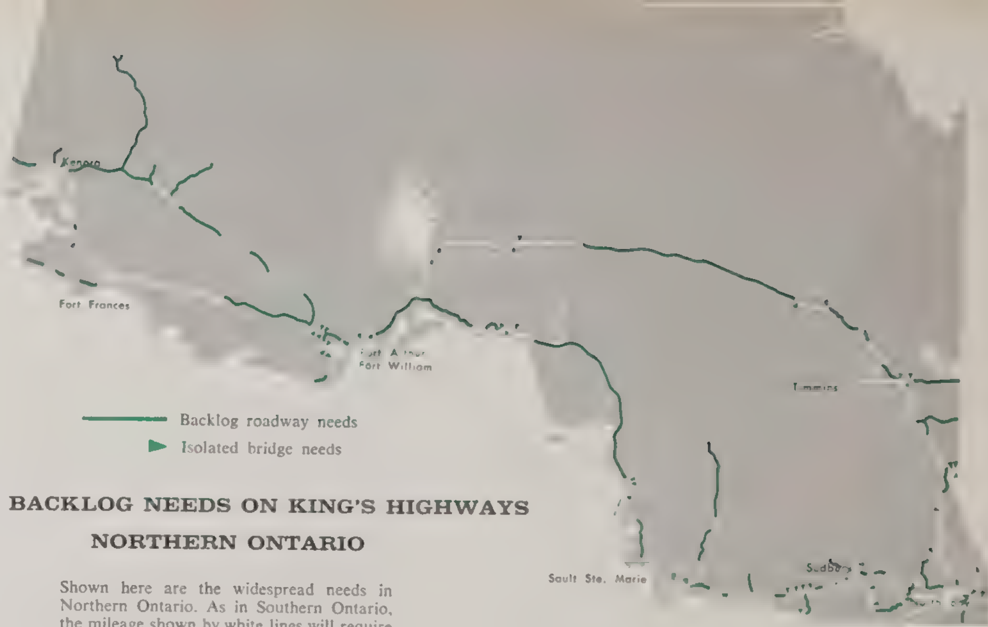
Estimates for total future costs also reflect the effect which new construction is expected to have on maintenance needs. Added mileage and increased widths will raise the costs, but improved surfaces will partially off-set the increases. Altogether, future maintenance needs on rural King's Highways are expected to average $25.9 million per year, reaching a figure of $31.3 million at the end of 20 years. All estimates are based on the average price levels for wages, equipment and materials in effect during the years 1951, 1952, and 1954. Any future changes in these price levels will affect the costs of maintenance.

A detailed study has not been made of adminstrative costs. Direct design and construction engineering have been included as part of construction costs. In this study, six percent of the proposed program costs have been added for general administration.

Winter conditions like those shown on Highway No. 26 near Owen Sound illustrate why almost 40 percent of maintenance costs of King's Highways must pay for snow removal.

ALTERNATIVE CATCH-UP PROGRAMS

The backlog of work totalling $647 million on rural King's Highways can be done quickly or slowly, depending on how much money is avail-



BACKLOG NEEDS ON KING'S HIGHWAYS NORTHERN ONTARIO

Shown here are the widespread needs in Northern Ontario. As in Southern Ontario, the mileage shown by white lines will require improvement within 20 years.

able. Naturally, it would be desirable to catch up to current traffic needs as soon as possible, but it would be wholly impractical to suggest that it be done in one or two years. That would require spending $647 million in one year, or $323 million each year for two years — plus maintenance and other costs. Engineers, plans, contractors and materials would not be available for such a "crash" program, even if funds were appropriated.

Clearly then, the catch-up work must be spread out over a period of several years, during which new needs will arise from increasing traffic demands and the wearing out of pavements; and all through this period, maintenance and administration must be continued.

As a basis for determining the speed at which the Province might best catch up, and the sums of money which should be spent each year — three alternative proposals are presented: a catch-up period of 10 years, one of 15 years and another of 20 years. These proposals include all costs that can be foreseen in connection with rural King's Highways, as has been described under the heading "Cost Elements".

As the accompanying table shows; a 10-year catch-up period would require an average of $149.2 million annually for 10 years; a 15-year period would reduce annual costs to $125.9 million; and a 20-year catch-up period would cost $112.5 million per year.

Over 20 years total expenditures would not differ by very much regardless of which program was selected. However, the stop-gap costs would be reduced by adopting the 10-year period enabling a net saving of 2.5 percent of 20-year costs. Furthermore, the many benefits of improved highways would be obtained sooner with a shorter catch-up period.

HIGHWAY CLASS PROGRAMS

The preceding data have covered the recommended rural King's Highway System as a whole. Separate programs for the three catch-up periods, including the elimination of both accruing and backlog deficiences, have been calculated as well for each of the four classes of the King's Highway System, as shown in Table Two.

Table Two

RURAL KING'S HIGHWAY SYSTEM

Average Annual Total Costs of Alternative Programs

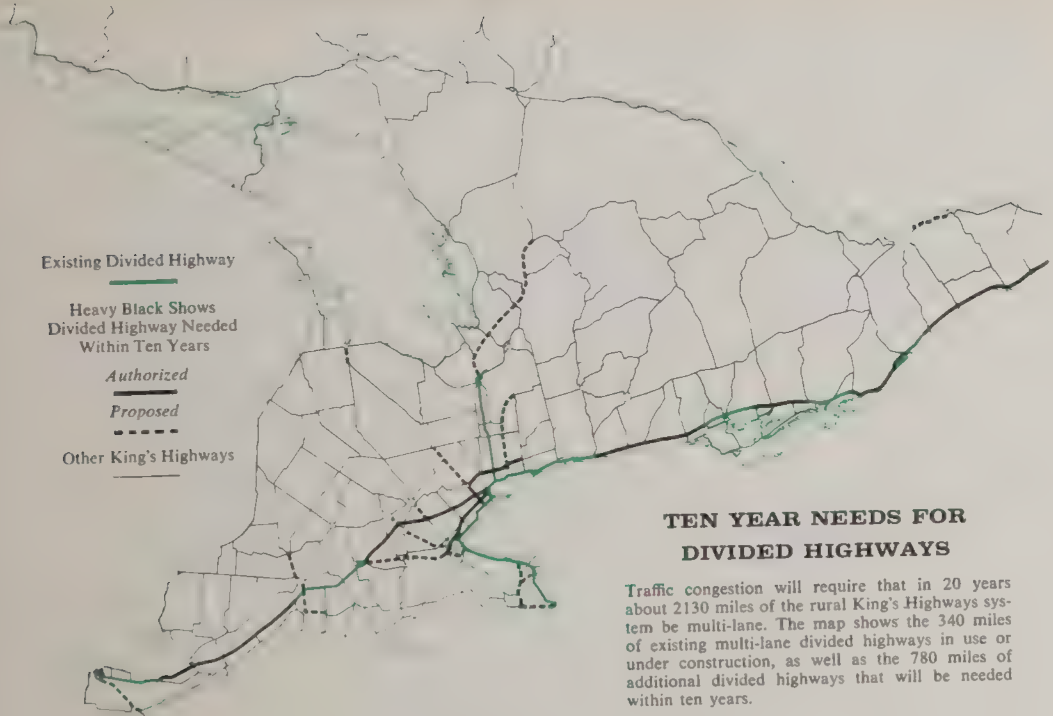
	CATCH-UP PERIOD		
Highway Class	*10 years*	*15 years*	*20 years*
Freeway	$ 38,140,000	$ 32,867,000	$ 28,204,000
Major Trunkline	41,159,000	34,513,000	32,119,000
Other Trunkline	34,089,000	29,521,000	26,571,000
Feeder	35,774,000	28,990,000	25,651,000
Total per year	**$149,162,000**	**$125,891,000**	**$112,545,000**

These data permit decisions concerning allocation of funds to each class, and variation of the rate of expenditure on each, if desired. For example, a 10-year program might be selected for the Freeway class, a 15-year program for Trunklines and a 20-year program for Feeders. In such an event, total average annual costs for the first 10 years, as selected from the above table, would be:—

Freeway	$38,140,000
Major Trunkline	34,513,000
Other Trunkline	29,521,000
Feeder	25,651,000
Total per year for 10 years	*$127,825,000*

IMPROVEMENTS NEEDED

Within the 20-year period, almost 10,000 miles of work are required on rural King's Highways to meet the standards for 1976 traffic. The work



TEN YEAR NEEDS FOR DIVIDED HIGHWAYS

Traffic congestion will require that in 20 years about 2130 miles of the rural King's Highways system be multi-lane. The map shows the 340 miles of existing multi-lane divided highways in use or under construction, as well as the 780 miles of additional divided highways that will be needed within ten years.

should be done when existing roads fall below limits of tolerable physical condition or capacity. Some 3,729 miles of roadway construction should be carried out, and 808 bridges should be built, as soon as possible to remedy intolerable conditions that existed as of April 1, 1956. This is the "catch-up" work already described, which must be spread over a period of years.

Total needs are:—

Needed Now	3,729 miles	808 bridges
1-10 years	3,483 miles	365 bridges
11-20 years	2,773 miles	259 bridges
Total 20 years	*9,985 miles*	*1,432 bridges*

It will be noted that the total is greater than the system's mileage. Many multi-lane sections are planned for stage construction — building two lanes first and adding other lanes later. In addition, future resurfacing and stop-gaps will increase the miles of work above the figures cited.

The maps on pages 43 and 45 show the general location of proposed road improvements that are needed now in Southern and Northern Ontario. This group of roads which need improvement now has general priority in future construction plans, and it was largely from this that work programs for the next few years were chosen.

MULTI-LANE HIGHWAYS

Relief of traffic congestion is a most important objective of the improvement program. Within 20 years, about 1,820 miles of multi-lane highways should be added to the 310 miles already in service, or under construction. General locations of the mileage needed within 10 years are shown in the map on this page.

All 800 miles of the Freeway class, described in Chapter III, are planned ultimately to be multi-lane divided highways, with full control of access, and with no cross traffic, left turns, level crossings or traffic signals. About 230 miles or 29 percent of the required mileage is now in service or nearing completion. Some 400 miles more are needed now to replace currently out-moded, overcrowded highways. The remaining 170 miles will be needed within 20 years.

Many other multi-lane divided highways are needed to supplement the Freeway system. Where possible, existing roads will be used as part of such facilities; but where new locations are necessary, control of access will be provided. The plan calls for multi-lane roads to serve all major traffic streams, and to connect most major cities either directly or via the Freeways.

Altogether, all types of multi-lane highways will require 60 percent of the total expenditure needed in 20 years for initial roadway construction. Costs for right-of-way are a considerable part of the total, as shown in Table Three.

Table Three

RURAL KING'S HIGHWAY SYSTEM

Itemized Costs on Multi-lane Highways *

	FREEWAYS	OTHER CLASSES
Right-of-way	$ 25,572,000	$ 77,635,000
Grading & Drainage	117,218,000	152,391,000
Surfacing	159,802,000	143,473,000
Engineering & Contingencies	15,139,000	33,459,000
Total	**$317,731,000**	**$406,958,000**

* Cost of bridges not included.

TWO-LANE HIGHWAYS

Some 75 percent of the mileage of the King's

Highway System will remain two-lane highways by 1976.

To bring them up to proper standards of width, curvature and other design features, and to provide proper surfaces, will require 43 percent of initial roadway construction cost. Work and costs involved are shown in Table Four.

Table Four

RURAL KING'S HIGHWAY SYSTEM

Itemized Costs On Two-lane Highway*

	MILES	TOTAL COST	COST PER MILE
Right-of-way		$ 29,815,000	
Resurfacing	2,415	112,382,000	$ 46,535
Reconstruction	3,390	309,191,000	91,207
New Construction	800	103,603,000	129,504
Total	**6,605**	**$554,991,000**	**$ 84,026**

* Cost of bridges not included.

About 40 percent of the mileage and 47 percent of the costs are needed now; this being the backlog of two-lane work that should be completed as soon as possible.

STRUCTURES AND RAILROAD PROTECTION

As already recorded, 1,432 new or rebuilt bridge structures will be needed on King's Highways in the next 20 years, at a total cost of $128.6 million. These include new grade separations at railroad crossings and at highway intersections. The

Bridge construction, shown here on Highway No. 28 near Burleigh Falls, is difficult and expensive. These vital structures make up, on the average, less than one percent of a highway's length, but consume almost 10 percent of construction funds.

following table shows the requirements:—

	Number	Cost
Stream Crossings	818	$ 64,653,000
Highway Separations	386	43,464,000
Railroad Separations	228	20,537,000
Total	*1,432*	*$128,654,000*

About 56 percent are needed now, and should be constructed as soon as possible. Some 77 percent of the highway separations and 29 percent of the railroad separations are required to develop the 800 miles of Freeways.

In addition, $222,000 is needed for signals, gates and flashers at level railroad crossings which would not be separated.

URBAN SECTIONS

All sections of King's Highways in towns of 1,000 to 5,000 population were analyzed for improvement needs. About 90 percent of the 285 miles included in this part of the study are either the complete responsibility of the Department of Highways or are administered under connecting link agreements between the municipalities and the Department. It is recommended that all such sections be assumed so that a uniform policy can be followed for the 158 towns affected. These communities have many traffic bottlenecks that need to be eliminated.

Even worse conditions exist in many larger cities, but studies have not yet been made to determine the solutions, costs and policies of provincial responsibility with respect to them. When such studies are made, they may show that changes are needed in present plans for the location and design of some rural roads.

For places of 1,000 to 5,000 population it is estimated that $30.6 million should be spent for construction improvements on King's Highways by 1976 to provide for reasonable traffic movement. About 37 percent of this amount or $11.4 million is needed now to remedy existing intolerable conditions. Under the existing arrangements the Department would contribute about 70 percent of these costs.

More work within towns and villages would be required if the construction of Freeways and other by-passes had not been planned to divert through traffic from the streets of these communities. Such diversion will open up many streets for easier access to local business and shopping. Nevertheless, connections to bypasses will be required, and where no bypass is planned, street widening, resurfacing, development of pairs of one-way streets, and certain street-openings and bridges are needed.

Total annual costs for three catch-up programs, covering construction, maintenance and administration on King's Highways in towns of 1,000 to 5,000 population are shown in the following table:

Catch-up Period	*Average Cost Per Year*
10 years	$3,996,000
15 years	3,183,000
20 years	2,867,000

SECONDARY ROADS

Some $224.6 million are needed for initial improvements by 1976 on Secondary Roads under the jurisdiction of the Department of Highways. This amount covers 2,184 miles of existing Secondary Roads that were not proposed for transfer to the King's Highway System, some routes currently designated as King's Highway, and some work to be done on existing King's Highways after their replacement by new locations.

Of the total cost, 55 percent is needed now, principally owing to poor surfaces and weak bridges—especially on presently designated Sec-

Secondary Roads, such as No. 612 located in the Sault Ste. Marie district, shown here, are largely low-class roads in undeveloped areas. However, they provide a necessary service and must be maintained by the Department.

ondary Roads. Of the 395 bridges on the latter, 98 percent should be replaced now, if feasible.

Initial needs are summarized in Table Five:—

Table Five

***SECONDARY ROADS**

Initial Construction Required

(*Cost in thousands of dollars*)

	ROADS		BRIDGES		
When Needed	*Miles*	*Cost*	*No.*	*Cost*	*Total Cost*
Now	1,769	113,428	442	10,882	124,310
1-10 years	1,258	75,248	24	1,939	77,187
11-20 years	396	21,237	41	1,839	23,076
Total	**3,423**	**209,913**	**507**	**14,660**	**224,573**

* Including certain other routes under provincial jurisdiction.

Work averages $61,300 per mile, excluding bridges. Standards are in keeping with the light traffic that most of these roads carry.

Average annual costs, including replacement, stop-gaps, maintenance and administration, for three catch-up periods are shown below:

Catch-up Period	*Average Cost Per Year*
10 years	$30,275,000
15 years	24,544,000
20 years	21,510,000

SUMMARY AND EVALUATION

The Province should plan on expenditures totalling $2.7 billion in 20 years for all highways that are now, or should be, under its direct jurisdiction. This figure is composed of elements summarized in the accompanying Table Six, and is subject to future revision as prices rise or fall and as continuing study shows that changes in the basic plan are warranted. No municipal subsidies are included in the costs.

The major problem is to eliminate the large backlog of work, totalling $782 million, which should be accomplished as soon as possible.

Annual costs are greater during shorter catch-up periods, as illustrated in Table Seven, but *total* costs over the 20-year period are about the same, less some savings in stop-gap measures if the ultimate improvements are accomplished as rapidly as they become needed.

Table Six

SUMMARY
PROVINCE-CONTROLLED ROUTES

20-Year Total Costs

(*in thousands of dollars*)

	CONSTRUCTION	MAINTENANCE	ADMINISTRATION	TOTAL
Rural King's Highway	1,590,620	532,880	127,400	2,250,900
Urban King's Highway Sections (in places 1,000 to 5,000)	33,320	20,790	3,230	57,340
Secondary Roads	272,680	133,160	24,360	430,200
Total	**1,896,620**	**686,830**	**154,990**	**2,738,440**
Average Per Year	**94,831**	**34,341**	**7,750**	**136,922**

KING'S HIGHWAYS COST PER VEHICLE-MILE OF TRAVEL

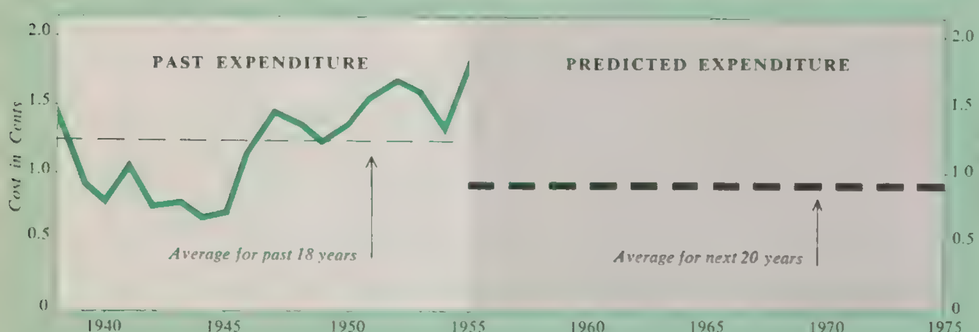


Table Seven

PROVINCE-CONTROLLED ROUTES

Annual Costs of Alternative Programs

(*in thousands of dollars*)

	CATCH-UP PERIOD		
	10 Years	*15 Years*	*20 Years*
Rural King's Highway	149,162	125,891	112,545
Urban King's Highway Sections	3,996	3,183	2,867
Secondary Roads	30,275	24,544	21,510
Total (per year)	**183,433**	**153,618**	**136,922**

These estimated annual expenditures indicate the increase required in the present outlay, which, in 1955, was about $121 million.

EVALUATION

With the facts now available, it is highly desirable that the legislature relate all aspects of its highway policy to a continuing program of specified dimensions.

For example, if a 20-year catch-up period were adopted, an average of $7.9 million would be needed annually for right-of-way purchases; but should a 10-year program be adopted, then the annual amount should be doubled for this period. Likewise more personnel, equipment and materials would be needed. With some assurance of long-range continuity, a reasonable increase in all these is possible.

Some conception of total requirements can be gained from the following summary of the initial construction program for 20 years. Some four-fifths of these amounts are actually needed within 10 years.

Right-of-way	$ 158,396,000
Grading & Drainage	571,960,000
Surfacing	659,011,000
Engineering & Contingencies	118,645,000
Bridges	155,921,000
Total	$1,663,933,000

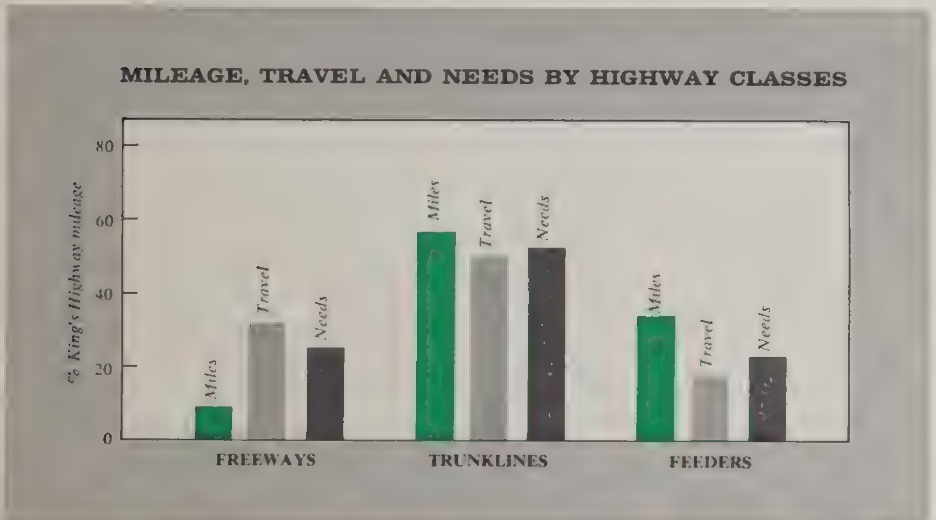
The economic feasibility of costs of future improvements may be judged by referring them to common indices and comparing them with past performance. The following table relates the average costs of the proposed future 20-year program, and actual expenditures on the King's Highway System over the past 18 years, to the average total number of vehicles, the mileage traveled on King's Highways, and the total population estimated for the same periods. No correction has been made for changes in the value of the dollar.

KING'S HIGHWAY SYSTEM

Total Expenditure

	PAST 18 YEARS		FUTURE 20 YEARS	
per vehicle mile	1.33	cents	0.88	cents
per registered vehicle	46	dollars	36	dollars
per person	10	dollars	15	dollars

Past amounts would have been greater had it not been for reduced expenditures in the war years, as may be seen in the chart on page 49.



PRIORITY PROGRAM

The engineering appraisal has provided the broad outlines of a long-range highway program and has developed a general plan for specific highway improvements. It has also provided a systematic, factual and uniform basis for determining which improvement projects are of the greatest urgency on the King's Highways.

As described in Chapter IV, all existing road sections and bridges were analyzed to determine whether they were at present "tolerable". At the same time, the *degree* of deficiency, if any, of all King's Highways was determined in terms of the three sufficiency-rating categories and in terms of the cost per vehicle mile for improvements.

Roads and bridges found to be tolerable are, by definition, not urgently in need of improvement—though they may become so in the near future. The backlog is the work associated with already intolerable facilities and the maps on pages 43 and 45 show the locations of such needed-now work. Much of this backlog work has been needed for some years.

Since the cost—$647 million—is so large, the backlog work will take some years to complete,

Table Eight

PROVINCE-CONTROLLED ROUTES

Allocation of Costs under Alternative Programs

(in percentages of total cost of each program)

PROGRAM PERIOD	RURAL KING'S HIGHWAY	URBAN KING'S HIGHWAY SECTIONS*	SECONDARY ROADS	TOTAL
10-year Catch-up				
New Construction	59	1	11	71
Stop-gaps & Replacements	4	–	1	5
Maintenance & Administration	18	1	5	24
Total	**81**	**2**	**17**	**100**
15-year Catch-up				
New Construction	55	1	10	66
Stop-gaps & Replacements	5	–	1	6
Maintenance & Administration	22	1	5	28
Total	**82**	**2**	**16**	**100**
20-year Catch-up				
New Construction	52	1	8	61
Stop-gaps & Replacements	6	–	2	8
Maintenance & Administration	24	1	6	31
Total	**82**	**2**	**16**	**100**

* Sections of King's Highways through villages and towns having a population of 1,000 to 5,000. Some added mileage in larger places has also been assumed by the Province, or has connecting link agreements. Costs for this mileage are not included in the estimates.

the time required depending on funds available and on other factors previously pointed out. It is necessary, therefore, to choose which of the backlog jobs—all intolerable now—are most urgent and most practical to construct first.

The sufficiency ratings were used as initial guides to that selection. Of all backlog work, those projects having the poorest physical condition were listed first, regardless of adequacy in other respects, because it was evident that something must be done to improve them at once. Next, roads that were severely congested were added, then those having the next worst ratings of condition, and so on. Where ratings of one category were similar for a number of locations, these locations were ranked, according to the severity in one of the other ratings, as, for example, the geometric (curves, widths, etc.) sufficiency. The process was continued until all backlog projects were arrayed.

Further study was given to road sections and bridges so selected. Reasonable continuity of proposed work and its integration with existing facilities were considered. Special factors, such as the need for bypass routes and over-all system development were not overlooked. At least a minimum amount of work was specified for each highway district, both to utilize personnel effectively and to avoid disruption of traffic where needs were unusually great.

In this way priorities were assigned to the road and bridge construction projects included in the backlog. These priorities provide a basis for the selection of annual work programs. Such priority studies must be carried out periodically to maintain a long-term picture of work requirements and to establish firmly one year in advance, programs that are within the framework of the over-all study.

OTHER PRIORITY FACTORS

The amount of money allotted for construction on the King's Highway System will largely determine the speed at which improvements are made. The amount that can be allotted will depend not only on total appropriations, but on amounts budgeted for King's Highway connecting links in cities and towns, for Secondary Roads, for municipal subsidies and for maintenance of all highways under provincial jurisdiction.

The over-all study provides guides in making decisions on such matters with the exception of municipal subsidies. In summary, the accompanying Table Eight shows the percentages of total funds required, for each of the three backlog catch-up periods.

Another major factor influencing priority of work is the relative importance of systems. This was discussed in Chapter III, and again on page 45, in this chapter. In summary, the following table shows the relative degree of urgency of construction work alone on the several classes of King's Highways.

CONSTRUCTION BACKLOG

(Rural Highways and Structures)

KING'S HIGHWAY CLASS	COST	PERCENT OF 20-YEAR NEEDS
Freeway	$219,201,000	50
Major Trunkline	176,303,000	37
Other Trunkline	111,237,000	32
Feeder	140,016,000	42
Total	**$646,757,000**	**41**

All other things being equal, greater benefits are provided to more people more quickly by concentrating a relatively high proportion of funds on Freeways and Major Trunklines, because of their more concentrated service function, than by spreading the funds more evenly among all classes of King's Highway.

Finally, the physical problems involved in getting work under way affect the initial selection made, which was based on need. Highway projects differ in complexity, some requiring more preliminary work than others. Location studies, right-of-way purchase, and preparation of plans require considerable time. While those actions are being taken, other needed projects that require but little time to get under way may be built. In addition, continuity of design over long sections is desirable, especially on the Freeway System; also new locations must be connected to existing highways at logical points in order to make them usable. In the process an old facility is sometimes replaced sooner than would otherwise be required. In this way the best possible improvement program can be selected.

CONCLUSION

Ontario's economic future and the welfare of its citizens depend in large measure on the adequacy of its principal highway routes. Investment in improved highways has lagged behind the needs of mounting traffic, with the result that there are large mileages that now fail to provide a tolerable degree of service.

This report gives a factual and conservative statement of what is required to catch up and then keep up with highway needs. It provides for a long-range highway development plan into which annual work programs can be geared with reasonable assurance that individual projects will fit permanently into the ultimate system.

There is a pressing need for acceleration of the construction effort to overcome the backlog of work as soon as is feasible. The longer this is deferred, the greater will be the costs if Ontario is to enjoy an adequate highway system.

If a continuing program of specified magnitude can be generally assured for some years into the future, then all concerned with highway building can step up their operations to meet the program.

Furthermore, budget decisions as to distribution of funds among the various highway responsibilities of the Province are required for maximum efficiency in achieving the goals outlined in this study.

When this policy has been decided, it will be possible further to refine the processes of advance planning. Three-year to five-year plans will be needed, as a result of which engineering, right-of-way purchase, and construction can be done more efficiently at lower cost with better results. Such advance planning is now under way to a much greater degree than formerly.

Continued change is characteristic of a dynamic economy, and highway affairs must keep pace. This report furnishes a sound basis for appropriate action that should lead to beneficial results. Appraisal and study are on a continuing basis and future adjustments will be made as research shows the need. Of special importance are city problems and municipal subsidies; these will be among the subjects of continuing study by the Department of Highways of Ontario.

Two-lane highways will make up 75 percent of the King's Highway mileage at the end of the 20-year study period, in spite of the proposed multi-lane highway construction. The improvement of these roads to adequate standards, illustrated here on Highway 11 near Klotz Lake, is a vital factor in any development plan.

SUMMARY SHEET FOR DETERMINING

KING'S HIGHWAY ROADWAY NEEDS

AS OF APRIL 1 1956

DEPARTMENT OF HIGHWAYS OF ONTARIO

STATISTICS & ECONOMICS SECTION

PL SE 55

CODE BLOCK

IDENTIFICATION ________ 1956, By ________

1 Hwy ___ 2 Distr. ___ 3 Cont Sect ___ 4 Rat'g Sect ___ 5 Split No ___ 6 Length ___ Mi

7 Location From ________

To ________

8. Restricted Speed Zone Yes ☐ No ☐ Partly ☐

Code block: 2-6, 7-11, 12-14

CLASSIFICATION ________ 1956, By ________

9 PROVINCIAL: King's Highway, Secondary Road, Municipal Road, T C H, No Road Existing

10 RURAL-URBAN: Non Incorporated, Incorporated Assumed, Connecting Link, Non Assumed

FUNCTIONAL (11 ULTIMATE, 11A PRESENT): Freeway, Major Trunkline, Minor Trunkline, Feeder, None

Code block: 9, 10, 11, 11A — 5, 6, 80

ROAD DATA 1956, By

12 ACCESS CONTROL Full ☐ Partial ☐ Normal ☐ — 13 No Lanes ___ 14 Lanes Divid'd Yes/No ☐ — 15 Median Width ___

16 TERRAIN - Flat ☐ Rolling ☐ — 17 R/W Width ___

18 Surf Type ___ 19 Surf Thick ___ 20 Surf Width ___ 21. Surf Life Expect'y ___

22 Year Const'd ___ 23 Year Resurf'd ___ 24 Base Thick ___ 25 Number of Structures ___

26 Shoulder Type ___ 27 Shoulder Width ___ 28 Number Grade RR Crossings ___

29 HOR CURVES Over ___ Deg. (No. / Degree) — 30 GRADES Over ___ % (No / % / Length)

31 % Length < 1500' SD ___ 32 NO SSD Rest ___ 33 Accident Rate ___ 34 Maint Demand ___

35 STRUCTURAL CONDITION — Surface, Shoulders, Sub Grade, Drainage: Good, Satisfactory, Poor, Very Poor

36 FLOODING Yes ☐ No ☐

37 SNOW PROBLEM Yes ☐ No ☐

38 Special Restrictions ___

Code block: 13, 14, 18, 20 — 8, 9, 20, 21 22

TRAFFIC DATA ___ 1956, By ________

39 1955 ADT ___ 40 1955 DHV ___ 41 PRACT CAP ___ 42 % COMM ___

43 1966 ADT ___ 44 1966 DHV ___ 45 Vol Cap Ratio 55 ___ 46 % Vol/Cap > 1.25 ___

47 1976 ADT ___ 48 1976 DHV ___ 49 Growth 1955 to 1976 ___

Code block: 39, 45 — 23 25, 26 27

ANALYSIS ________ 1956, By ________

PRESENT DEFICIENCIES — 50 Tolerable Condition No ___

51 Surface Cond ☐ 52 Surface Width ☐ 53 Surface Type ☐ 54 Shoulder Condition ☐

55 Shoulder Width ☐ 56 Grades ☐ 57 Base Condition ☐ 58 Pass Opportunity ☐

59 Stop S Dist ☐ 60 Drainage Cond ☐ 61 Horiz Alignment ☐ 62 Traffic Capacity ☐

63 Accidents ☐ 64 30 MPH Zone ☐ 65 Other

66 FUTURE DEFICIENCIES — Year: 1-5, 6-10, 11-15, 16-20, Over 20 — Structural, Capacity, Geometrics

67 WHEN IMPROVEMENT IS NEEDED — Now, 1-5, 6-10, 11-15, 16-20, Over 20

Code block: 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 63, 64, 67 — 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41

PROPOSED IMPROVEMENT ________ 1956, By ________

68 Design Class No

TYPE OF WORK — COST (Thousands of dollars)

69 Resurface Old Pavement / Pave present Grade ☐ — 70 Added Lanes ☐ — 74 R W ___

71 Reconstruction ☐ — 72 New Construction ☐ — 75 Grade and Drain ___

% Mileage New — 76 Base & Surface ___

73 Freeway ☐ Includes All Service Roads — 77 Sub Total ___

Cost includes: Resurfacing existing Lanes, With granular Lift, With Widening — 78 % Engr and Conting ___

79 Total ___

80 Structures ___

81 Grand Total ___

82 Length of Proj(a) ___

(a) May differ from section length in item No. 6

83 Constr Cost per mile (Items (No.75 + 76) ÷ No 82) $ ___ 84 Total cost per mile (Item No 81 ÷ 82) $ ___

85 STAGE OF WORK No Stages ☐ 1st Stage ☐ 2nd Stage ☐

86 NUMBER OF LANES Proposed Now ☐ Within 20 Years ☐

87 TRANSFERS Not Transferred ☐ Now ☐ 1-5 ☐ 6-10 ☐ 11-15 ☐ 16-20 ☐

Code block: 68, 74, 75, 76, 79, 82, 85, 86, 87 — 42 43, 44 47, 48 51, 52 55, 56-60, 61, 62-64, 65, 66, 67

PRIORITY 1956, By ___

88 Structural ___ 89 Capacity ___ 90. Geometric ___ 91 . Cost/VM ___ 92 Priority ___

Code block: 68 71, 72 73, 74 75, 76 79

REMARKS 1956, By ________

SUMMARY SHEET FOR DETERMINING

STRUCTURE OR RAILROAD PROTECTION NEEDS ON KING'S HIGHWAYS

As of April 1, 1956

DEPARTMENT OF HIGHWAYS OF ONTARIO

PL SE - 56

Card Control 1 ☐

CODE BLOCK

IDENTIFICATION

1. Hwy ___ 2. Distr ___ 3 Cont. Sect. ___ 4 Rat'g. Sect ___ 5 Split No. ___ 6 Struct.or X-ing No ___ — 1-2 — 2-6

7 Location ________ — 3-4 — 7-10

8 Restricted Speed Zone Yes ☐ No ☐ — 5-6 — 11-14

CLASSIFICATION

9. PROVINCIAL: King's Highway ☐, Secondary Roads ☐, T. C. H. ☐, Local Road ☐, No Road Existing ☐

10 RURAL-URBAN: Non-Incorporated ☐, Incorp. Assumed ☐, Connecting Link ☐, Non Assumed ☐

FUNCTIONAL (11. ULTIMATE, 11A. PRESENT): Freeway, Major Trunkline, Minor Trunkline, Feeder, None

Code block: 9 — 15; 10 — 16; 11 — 17; 11A — 80

EXISTING CONDITIONS — Structures Only

12 TYPE OF SERVICE: Stream Crossing ☐, Highway Separation ☐, R R Under Highway ☐, R R Over Highway ☐

13. TYPE OF STRUCTURE: Timber ☐, Concrete Slab ☐, Concr T-Beam ☐, Rigid Frame ☐, Steel Beam ☐, Steel Truss ☐, Steel Rigid Frame ☐

14. Length ___ — 13 — 19

15. Roadway Width ___ — 12 — 20

16 No Spans ___ — 15 — 21-22

17. Year Built ___ — 20 — 23-25

18. Vertical Clear'ce ___ — 17 — 26-27

19 Safe Loading ___ — 19 — 28

20 1955 A D.T. ___ — 24 — 29

21 % Commercial ___

Code block: 18

Railroad Grade Crossings Only

22 No Trains Per Day ___ 23. No. Tracks ___

24. Type of Protection: Signs only ☐ Signals Only ☐ Signals and Gates ☐

CHARACTER OF DEFICIENCIES — Very Poor, Poor, Fair, Adequate

25. R R Grade Crossing Protection — 25 — 30

26. Clear Width — 26 — 31

27 Vertical Clearance — 27 — 32

28 Structural Condition — 28 — 33

29. Traffic Capacity — 29 — 34

30 Other (Specify) — 30 — 35

31 Time of Improvement: Deficient now ☐ 1-5 Yr ☐ 6-10 Yr ☐ 11-15 Yr. ☐ 16-20 Yr. ☐ Ovr.20Yr ☐ — 31 — 36-40, 41

PROPOSED IMPROVEMENT — Structures Only

32 TYPE OF SERVICE: Stream Crossing ☐, RR Under Highway ☐, RR Over Highway ☐, Highway Separation ☐

33 TYPE OF WORK: Recond'n Exist'g Struct. ☐, Replace Same Location ☐, Replace New Location ☐, New Structure ☐

DESIGN DATA

34 Type ___ — 32 — 42

35. Length ___ — 36 — 43-44

36. Width ___ — 37 — 45

37. Design Loading ___ — 46-47

38. 1976 ADT ___ — 41 — 48-51

Railroad Grade Crossings Only — 39. SignalsOnly ☐ 40. Signals and Gates ☐ — 42 — 52-55

Code block: 33, 39 40 — 56-60, 61

COST ESTIMATE

41 Structure (and approach if any) $ ___ Total Cost of Interchange — 35 — 62-65, 66

42 RR. Protection $ ___ Approaches $ ___ — 43 44 — 68-71

PRIORITY

43 Structural ___ 44 Capacity ___ 45 Geometrics ___ 46 Priority No. ___ — 45, 46 — 72-75, 76-79

47. TRANSFERS Not Transferred ☐ Now ☐ 1-5 Yr. ☐ 6-10 Yr. ☐ 11-15 Yr. ☐ 16-20 Yr. ☐ — 47 — 67

DESIGN STANDARDS FOR KING'S HIGHWAYS

PLANNING AND DESIGN BRANCH
DEPARTMENT OF HIGHWAYS OF ONTARIO

CLASSIFICATION		FREEWAYS (a) & MAJOR TRUNKLINES		OTHER KING'S HIGHWAYS (b)							
TYPE		MULTI LANE (c) (Divided)	2 LANE	MULTI LANE (c) (divided)	TWO LANE						
CLASS NUMBER		1	2	3	4	5	6	7	8	9	10
ESTIMATED 20 YEAR A.A.D.T.					3000-5000 (d)	2000 — 3000		1000 — 2000		Under 1000	
TERRAIN		ALL	ALL	ALL	ALL	Flat	Rolling	Flat	Rolling	Flat	Rolling
DESIGN SPEED – (m.p.h.)		70	70	70	70	70	60	60	50	50	50
OPERATING SPEED (m.p.h.)		50-55	50-55	45-50	45-50	45-50	45-50	45-50	40-45	40-45	40-45
DESIGN	Percent 1500'	1000 per lane		1200 per lane with							
CAPACITY	Sight Distance 100 %	With access control	600 v.p.h.	Access control	900 v.p.h.	900 v.p.h.		Not		Not	
Vehicles	Available 80 %	600 per lane	550	700 per lane without	800	800		Applicable		Applicable	
Per Hr. (e)	Per mile 60 %	Without access control	500	Access control	690	690					
CURVATURE — Maximum Degree		3	3	3	3	3	4.5	4.5	7	7	7
STOPPING SIGHT DISTANCE – Feet		600	600	600	600	600	475	475	350	350	350
GRADIENT – Maximum Percent		3(f)	(g)	3(f)	(g)	(g)	(g)	4(h)	7(h)	4(j)	7(j)
LANE WIDTH — Feet		12	12	12	12	12	11	11	11	11	11
SHOULDER WIDTH — Feet (k)		10	10	10	10	8	8	8	6	6	6
RIGHT OF WAY WIDTH — Feet (n)		300	120	200	120	120	120	100	100	100	100
SURFACE TYPE (m)		5¼ inch asphaltic concrete		4¼ inch asphaltic concrete		3¼ inch asphaltic concrete					
STRUCTURES	CLEAR WIDTH	p	q, r	p	q, r	q, s	q, t	q, u	q, u	q, u	q, u
	LOADING	H 20 – S 16									
	VERTICAL CLEARANCE	15 Feet									

NOTE: 1. Certain design features such as curvature, gradient, and sight distance to be better than standard if possible at no extra cost.
2. In urban-like congested areas outside incorporated limits, or in rural-like sections inside incorporated places, design and operating speeds may be reduced 10 m.p.h., with appropriate curvature and sight distance. This does not apply to Freeway design.

a. All Freeways to have complete control of access. New locations of Major Trunklines to have maximum practical partial control of access.
b. Minor Trunklines to have Design Speed of not less than 60 m.p.h.
c. Median Strip is required, - width at least 60 feet except in special cases.
d. For volumes in this range, capacity studies may indicate need for four lanes.
e. Equivalent passenger vehicles — Total traffic ways for two lanes. For multi lanes per lane capacity in the direction of heavier flow.
f. May be increased to 5% in special cases.
g. 3% maximum for standard capacity. Over 3% to 7% grades require special capacity analysis for climbing lanes, 7% maximum any location.
h. Less 1% for grades more than 1000'. Add 1% for grades less than 500'.
j. Add 1% for grades less than 750'.
k. Distance from edge of pavement to inner edge of rounding.
m. Granular bases will be designed in accordance with anticipated loads and soil conditions.
n. To be 150 feet throughout for two lane roads in northern Ontario.
p. i) Widths herein apply only to 4-lane divided without speed-change lanes or sidewalk.
ii) Span 100 ft. or less — single structure, two roadways 34 ft. curb-to-curb with 20 ft. median; twin structures, 37 ft. curb-to-curb on each.
iii) Span over 100 ft. — single structure, two roadways 27 ft. curb-to-curb with 10 ft. median; twin structures, 30 ft. curb-to-curb on each.
iv) Underpass — 34 ft. abutment-to-median-curb, single opening to have 20 ft. median, double opening to have median wider than pier by 6 ft. each side.
q. Widths shown below provide for only 2 traffic lanes.
r. i) Span 100 ft. or less — curb-to-curb 44 ft. if no sidewalk, 41 ft. if one sidewalk, 38 ft. if two sidewalks.
ii) Span over 100 ft. — 30 ft. curb-to-curb, with or without sidewalk(s).
iii) Underpass — 44 ft. abutment-to-abutment.
s. Same as r. except 40 ft., 37 ft., 34 ft. respectively for span 100 ft. or less.
t. Same as r. except 38 ft., 35 ft., 32 ft. respectively for span 100 ft. or less.
u. i) Span 100 ft. or less — curb-to-curb 34 ft. if no sidewalk, 31 ft. if one sidewalk, 28 ft. if two sidewalks.
ii) Span over 100 ft. — 28 ft. curb-to-curb, with or without sidewalk(s).
iii) Underpass — 34 ft. abutment-to-abutment.

TOLERABLE CONDITIONS FOR KING'S HIGHWAYS *

PLANNING AND DESIGN BRANCH
DEPARTMENT OF HIGHWAYS OF ONTARIO

CLASSIFICATION	FREEWAY & MAJOR TRUNKLINE		OTHER KING'S HIGHWAYS								
TYPE	MULTI-LANE (Divided)	2 LANE	MULTI-LANE (Divided)	TWO LANE							
CLASS NUMBER	1	2	3	4	5	6	7	8	9	10
1955 TRAFFIC VOLUME A.D.T.				3000-8000	2000 - 3000		1000 - 2000		UNDER 1000	
TERRAIN	ALL	ALL	ALL	ALL	Flat	Rolling	Flat	Rolling	Flat	Rolling
DESIGN SPEED m.p.h.	60	60	60	60	60	50	50	40	40	35
CAPACITY Vehicles per hour	Ratio of 1955 Design Hour Volume to Practical Capacity not to exceed 1.25									
CURVATURE Maximum Degree	4.5	4.5	4.5	4.5	4.5	7	7	11	11	15
STOPPING SIGHT DISTANCE feet	475	475	475	475	475	350	350	275	275	225
PASSING SIGHT DISTANCE	Not Applicable	a	Not Applicable	a	a	■	Not Applicable			
GRADIENT Maximum Percent	5	5	5	5 b	5	6	6	8	8	10
GRADE LENGTH feet	c	800	c	800 b	800	700	700	500	500	400
LANE WIDTH feet	10	10	10	10	10	9	9	9	9	9
SHOULDER WIDTH feet	7	7	6	6	6	6	4	4	3	3
SURFACE TYPE	← No problem →			← Mulch →					Primed Gravel	
STRUCTURES CLEAR. WIDTH	← Surface Width Plus 1 Foot Per Lane →			← Surface Width Plus 2 Feet →						
STRUCTURES LOADING	← H 15 →									
STRUCTURES VERTICAL CLEAR.	← 12 Feet →									

* The tabulated values determine individual deficiencies. Road intolerability to be determined by overall evaluation of extent and character of individual deficiencies. In particular, any deficiency in Capacity, Lane Width, or Surface Type is intolerable, as is Accident-proneness. More general criteria that also determine intolerability are maintenance expenditure, condition and life of surface

a No more than 40 percent of distance to have less than 1500-foot Sight Distance
b For rolling terrain use figure for Design Class number 6
c No existing grades long enough to be a problem

DESIGN STANDARDS FOR SECONDARY ROADS (a)

PLANNING AND DESIGN BRANCH
DEPARTMENT OF HIGHWAYS OF ONTARIO

CLASS NUMBER	AS FOR KING'S HIGHWAY	11	12	13
ESTIMATED 1966 A.D.T.	OVER 1000	400 - 1000	150 - 400	UNDER 150
DESIGN SPEED m.p.h.		50	45	40
CURVATURE maximum degree		7	9	11
STOPPING SIGHT DISTANCE feet		350	325	275
GRADIENT maximum percent		7	8	10
SURFACE WIDTH feet	AS FOR KING'S HIGHWAY	22	20	18
SHOULDER WIDTH feet		4-6	4	4
RIGHT-OF-WAY WIDTH feet		100	86(b)	66(b)
SURFACE TYPE		MULCH	PRIME WITH DOUBLE SEAL	GRAVEL(c)
STRUCTURES CLEAR WIDTH		← 28 feet →		
STRUCTURES VERTICAL CLEARANCE		← 15 feet →		
STRUCTURES LOADING		← H20-S16 →		

NOTES

(a) Certain design features such as curvature, gradient, sight distance, to be better than standard, if possible at no extra cost.
(b) 100 feet in Northern Ontario.
(c) Gravel well-graded and stabilized.

SUMMARY OF INITIAL CONSTRUCTION COSTS BY DISTRICT FOR 20-YEAR PERIOD

(thousands of dollars)

District Number	District	Right-of-way	Grading & Drainage	Base & Surface	Engineering & Conting.	Structures & R.R. X-ings	Total
1	Chatham	31,091	24,367	43,809	6,209	10,050	115,526
2	London	14,668	40,613	58,189	9,538	14,031	137,039
3	Stratford	4,893	13,064	17,725	3,989	8,308	47,979
4	Hamilton	36,048	65,019	73,099	12,005	30,857	217,028
5	Owen Sound	2,674	15,785	19,095	3,323	3,093	43,950
6	Toronto	37,347	77,946	75,973	13,842	29,271	234,379
7	Port Hope	5,552	39,738	48,545	7,499	9,128	110,462
8	Kingston	4,814	29,574	45,253	6,712	5,298	91,651
9	Ottawa	7,243	40,277	51,765	12,505	8,959	120,749
10	Bancroft	862	22,233	15,167	3,821	2,244	44,327
11	Huntsville	3,020	49,727	30,458	7,121	7,799	98,125
13	North Bay	3,683	25,549	19,867	4,704	3,701	57,504
14	New Liskeard	1,463	18,482	24,775	5,384	5,331	55,435
16	Cochrane	206	5,336	13,975	1,762	3,658	24,937
17	Sudbury	1,300	22,966	22,828	4,674	2,098	53,866
18	Sault Ste. Marie	1,291	20,600	23,773	4,261	3,194	53,119
19	Fort William	1,862	35,403	30,126	6,704	4,546	78,641
20	Kenora	303	17,663	36,757	8,015	3,264	66,002
Totals		**158,320**	**564,342**	**651,184**	**122,068**	**154,810**	**1,650,724**

KING'S HIGHWAYS CAPACITY DEFICIENCIES BY TRAFFIC VOLUME

(As of April 1, 1956)

1955 ADT Group	Mileage with Deficient Capacity
UNDER 100	0
100 to 300	0
400 to 900	0
1000 to 1400	0
1500 to 1900	5.0
2000 to 2400	35.7
2500 to 2900	7.2
3000 to 3900	158.2
4000 to 4900	142.5
5000 to 5900	177.6
6000 to 7400	113.8
7500 to 9900	27.7
OVER 10000	28.1
Total	**695.8**

HISTORY OF EXPENDITURE

(thousands of dollars)

Year	(1) King's Highways	(2) Trans-Canada Highway	(3) Total King's Highways	(4) Secondary Roads (estimated)	(5) Municipal Subsidies	(6) Grand Total (3)+(4)+(5)
1938–9	32,935.2	—	32,935.2	4,145.2	4,896.8	41,977.2
1939–40	21,729.1	—	21,729.1	4,878.5	5,253.0	31,860.6
1940–1	19,857.6	—	19,857.6	1,790.6	4,659.0	26,307.2
1941–2	28,626.1	—	28,626.1	1,567.4	5,320.5	35,514.0
1942–3	15,048.3	—	15,048.3	1,143.0	3,589.1	19,780.4
1943–4	12,561.7	—	12,561.7	1,444.6	5,153.1	19,159.4
1944–5	11,361.4	—	11,361.4	1,221.4	6,006.8	18,589.6
1945–6	13,933.9	—	13,933.9	1,652.9	7,337.6	22,924.4
1946–7	33,261.3	—	33,261.3	3,051.1	9,446.1	45,758.5
1947–8	43,040.6	—	43,040.6	3,802.7	15,666.8	62,510.1
1948–9	43,267.0	—	43,267.0	6,185.6	18,890.0	68,342.6
1949–50	43,695.2	1,569.6	45,264.8	5,930.9	23,155.6	74,351.3
1950–1	54,231.0	2,749.3	56,980.3	5,966.4	22,992.1	85,938.8
1951–2	68,987.3	3,453.9	72,441.2	7,139.1	26,890.8	106,471.1
1952–3	79,915.8	4,103.8	84,019.6	10,927.9	29,692.1	124,639.6
1953–4	78,237.7	2,486.9	80,724.6	6,445.8	29,773.7	116,944.1
1954–5	70,290.5	6,274.5	76,565.0	6,280.7	35,066.1	117,911.8
1955–6	106,320.2	8,000.0 est.	114,320.2	6,284.3	44,464.0	165,068.5
Totals	**777,299.9**	**28,638.0**	**805,937.9**	**79,858.1**	**298,253.2**	**1,184,049.2**